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Aviation Classics MONTHLY

Spitfire XIV

BATTLE OVER BERLIN

Spitfire vs Fw 190

Nazi Mach 1 ambitions

Tribute to 24-victory RAF ace

WWII JET IN PROFILE

Gloster Meteor

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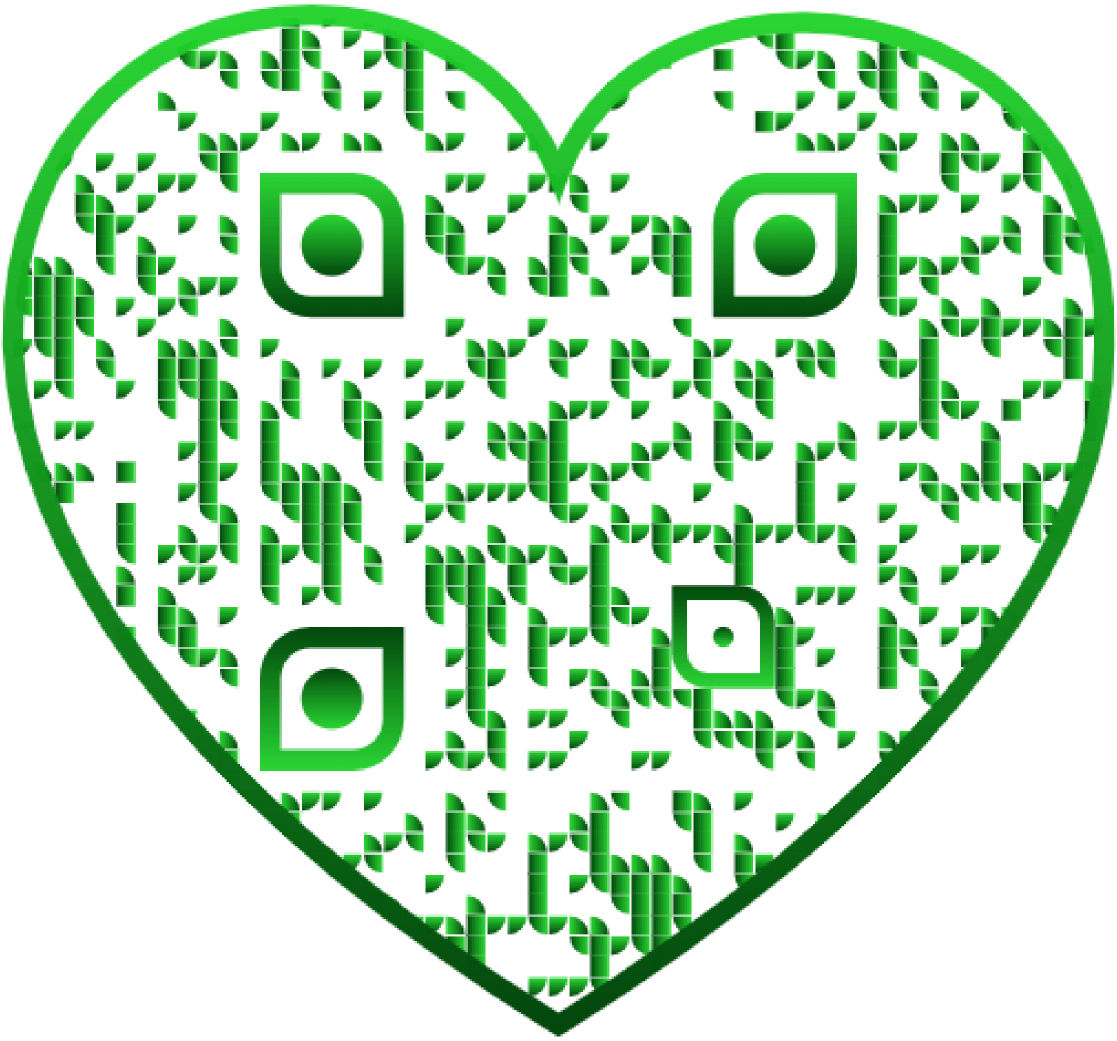

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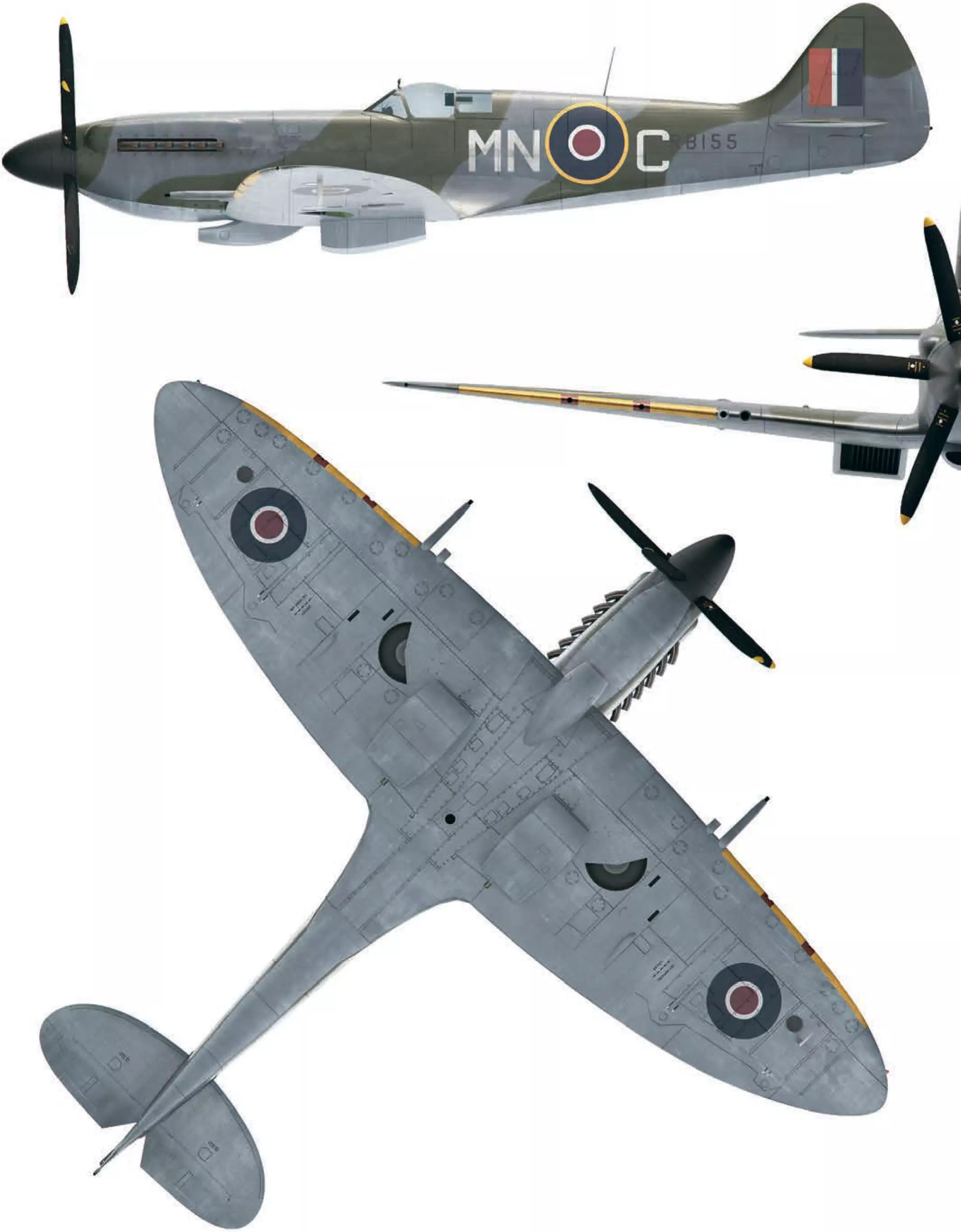

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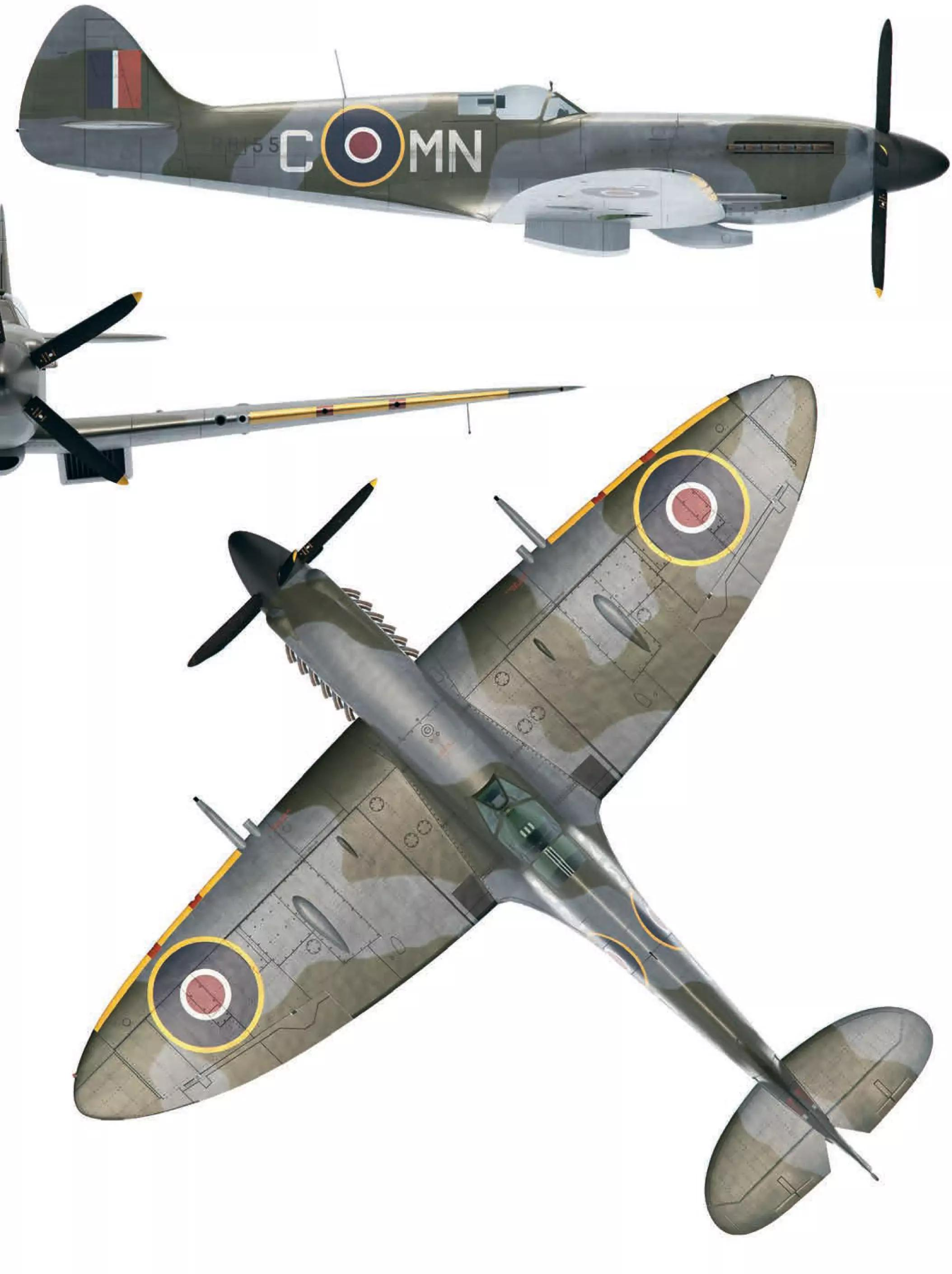

SPITFIRE Mk. XIV
SPECIFICATIONS

Claimed top speed	447mph
Ceiling	43,500ft
Rate of climb	5,100ft/min
Range (without drop tanks)	460 miles
Length	32ft 8in
Wingspan	36ft 10in
Empty weight	6,578lb
Armament (original)	2 x 20mm Hispano cannons 2 x .50 calibre machine guns

Supermarine Spitfire Mk XIV (Type 379)

Plans to fit a Spitfire with the 37-litre V12 Rolls-Royce Griffon – in place of the 27-litre Merlin – were first drawn up in 1939 but the engine's development problems delayed their implementation until 1942.

The first Griffon Spitfire, DP845, made its flight debut on November 27, 1941. Its airframe was similar to that of the Merlin-powered Mk III but with a bigger radiator and oil cooler, re-contoured engine cowling and four-bladed 10ft 5in propellor. Where the Merlin's prop, viewed from the cockpit, rotated to the right, the Griffon's rotated to the left – resulting in the aircraft swinging to the right on the ground, rather than the left.

DP845 subsequently became the prototype for the first in-service Griffon Spitfire, the Mk XII. A total of 100 were built from Mk Vc and Mk VIII airframes. However, the Mk XII's Griffon had only had a single-stage supercharger, hindering high-altitude performance.

This was rectified in the next Griffon Spitfire: the Mk XIV, which received the latest 60 series Griffon with two-stage supercharger. Where the Mk XII had proven around 14mph faster at sea level than the Spitfire Mk IX, the Mk XIV gave a more substantial performance increase. Test pilot Jeffrey Quill, having flown a 60-series equipped Spitfire on January 20, 1943, noted that the new engine gave "a spectacular performance doing 445mph at 25,000ft, with a sea-level rate of climb of over 5,000ft per minute".

Although the Mk XIV centre section was based on that of the Mk VIII, its engine was mounted 10in further forward to make room for the 2,050hp Griffon 65. To balance out the longer nose, a new tail unit was fitted with a taller, broader fin and rudder and the radio equipment was moved further back in the tail. Bigger radiators were installed too, as was a five-bladed prop. Later Mk XIVs were given a cut-down rear fuselage and full vision canopy.

The Mk XIV first entered service with 610 Squadron in December 1943. In operational use it could be tricky to handle, 17 Sqn pilot Don Healy remembering that it was "a hairy beast to fly and took some getting used to … Even with full aileron, elevator and rudder, this brute of a fighter took off slightly sideways".

Despite its excellent performance – the production model could manage 446mph at 25,400ft – the Mk XIV's greatest disadvantage was its limited range. With its two fuselage tanks and two wing leading edge tanks topped up to 109.5 gallons, it could still only manage 460 miles on internal fuel. Drop tanks were therefore often carried and an additional rear fuselage tank was later added.

The Mk XIV was the 2nd Tactical Air Force's main high-altitude air superiority fighter in northern Europe, with six squadrons operational by December 1944. Although some were sent to the South-East Asian Theatre, they arrived in June 1945 – too late to see combat against the Japanese. A total of 957 Mk XIVs were made. ■

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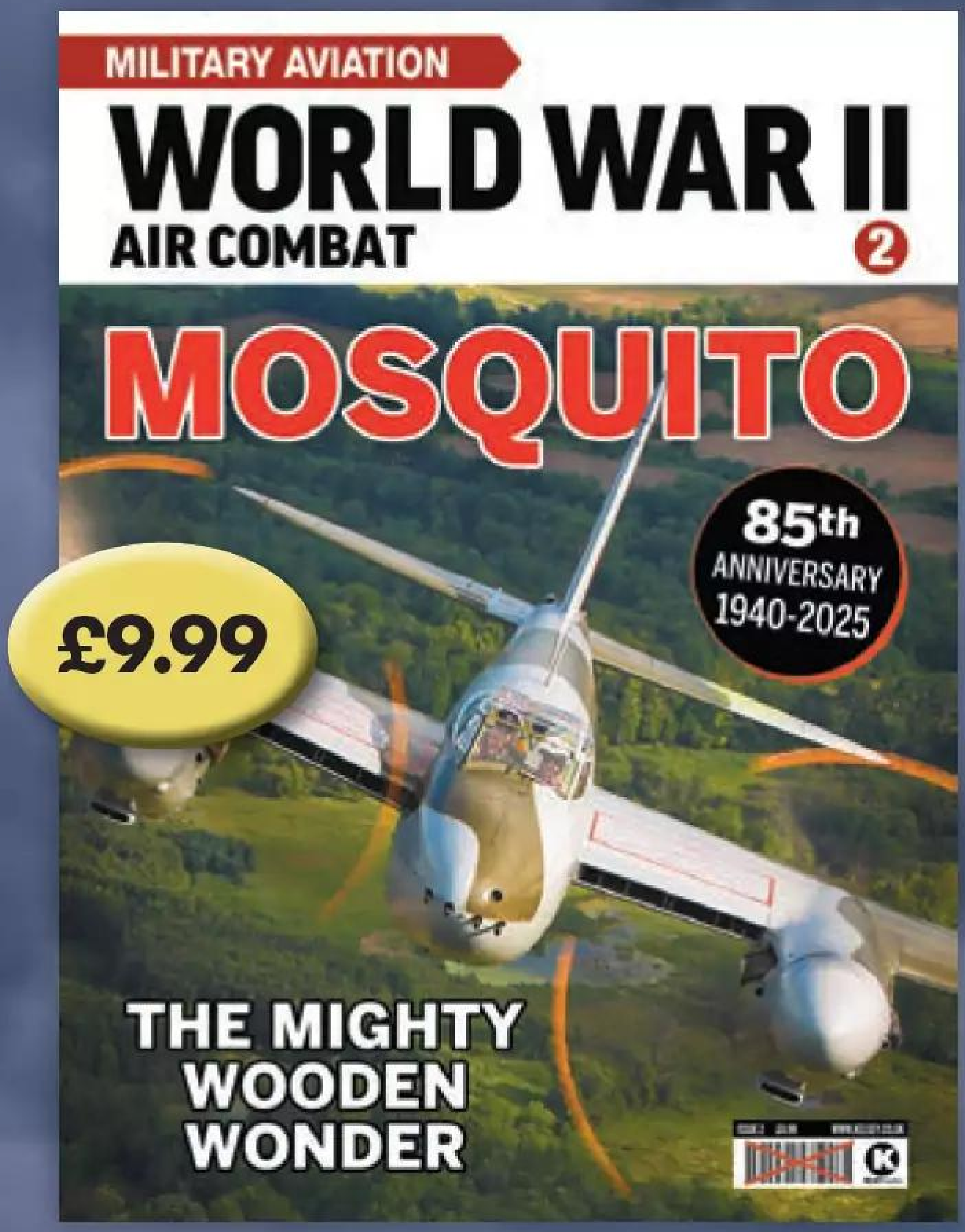
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Welcome

Welcome to the first issue of Aviation Classics Monthly.

This exciting new military aviation magazine will bring you a mix of World War II and Cold War stories on air battles as well as technical features on the aeroplanes and their development throughout WWII and beyond. Specially commissioned artwork will be used to bring these stories to life, and each issue will come with a gate-fold eight-page cover with poster artwork suitable for framing. Authoritative features will be complemented with news from the world of heritage military aviation, including developments with surviving aircraft still flying and those under restoration.

Following the News, our first feature relates a battle between seven Spitfires from 350 Squadron (Belgian), and Focke-Wulf Fw 190s on the fringes of Berlin in 1945. We then take a look back on the remarkable career of world record-breaking naval officer and test pilot Eric 'Winkle' Brown. Next, we feature the birth of the McDonnell Douglas F-15 Eagle, which is followed by a tribute to fighter pilot George Kemp Gilroy, DSO, DFC & Bar and the centrespread image courtesy of Ivan Berryman features George Gilroy in a Spitfire over the English Channel. Russian long-range jet bombers feature next which include the Type 50, Tu-14, Tu-82, Tu-16, Il-30, Il-46S, Il-54 and Aircraft 88, 491 and 494. The Gloster Meteor which was the only Allied jet to see active service during WWII is our next piece and our final feature this month, focuses on the Nazi Mach 1 ambitions with the rocket-propelled DFS 228, DFS P 1068 and DFS 346. To make sure of your copy each month, why not take out a subscription, go to pages 68-69 to get a great deal.

Enjoy the magazine.

Charlie

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Looking back on the remarkable career of the world record-breaking naval officer and test pilot.

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Developed at the Pentagon after observing modern Soviet designs and refined through the Vietnam War, the F-15 Eagle became a premier air-to-air fighter, but the journey to its first flight was lengthy.

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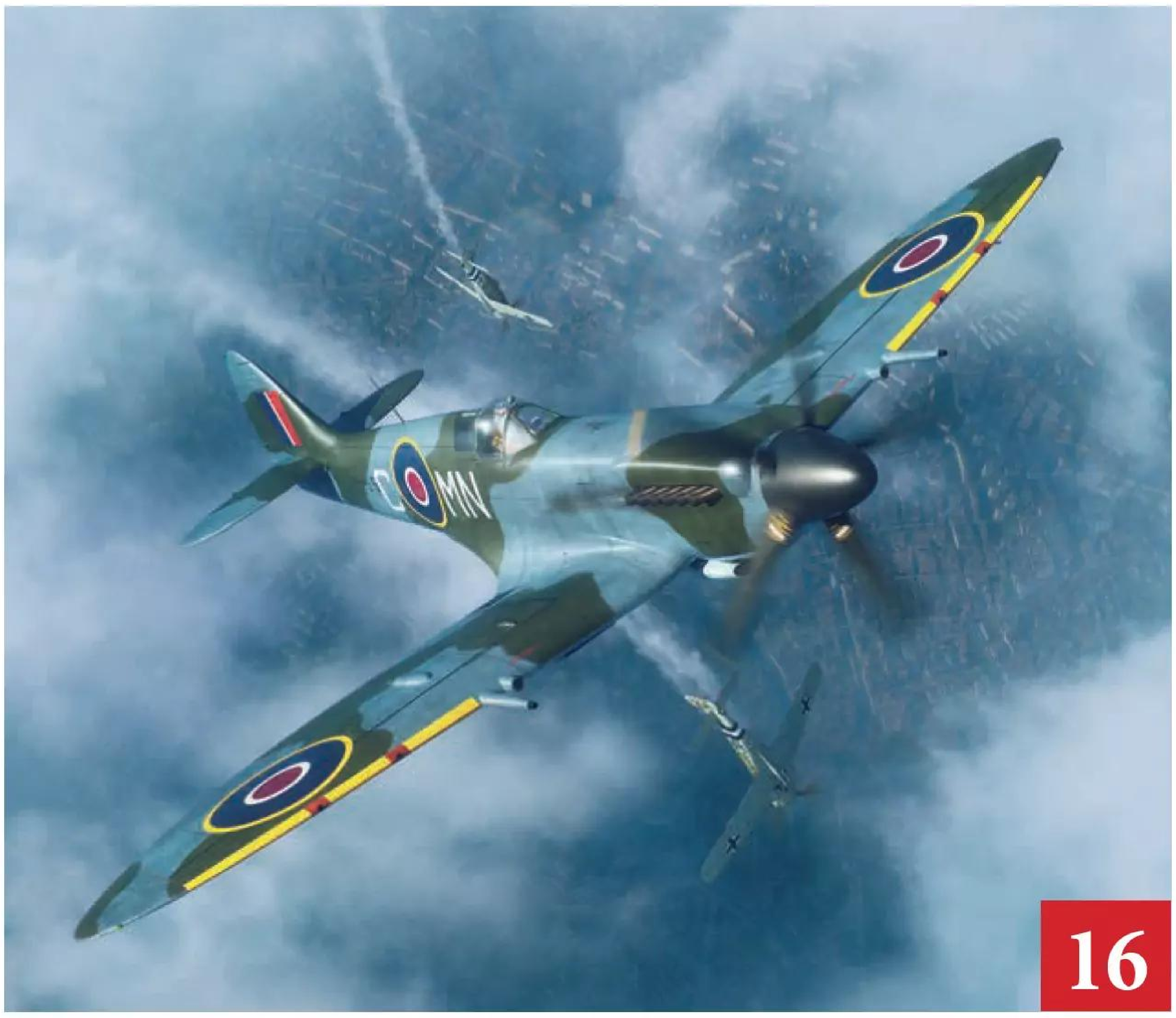

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The post-war period saw the Soviet Union expending vast resources to develop a fleet of high-speed strategic bombers. This force has remained a powerful and intimidating presence on the world stage right up to the present day.

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The only Allied jet to see active service during the Second World War was the Gloster Meteor. However, its primary career unfolded during the Cold War. Squadrons were stationed in Germany as the Iron Curtain

descended and continued to operate there into the mid-1950s. The Meteor remained in service with the Royal Air Force (RAF) for many years, primarily in secondary roles.

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Make a worthwhile saving by taking out a subscription to *Aviation Classics Monthly*.

70 NAZIS STRIVE FOR MACH 1

As the Second World War was entering its last stages, the German Air Ministry pressed ahead with a three-step programme of research ultimately intended to get a rocket-propelled manned aircraft through the sound barrier.

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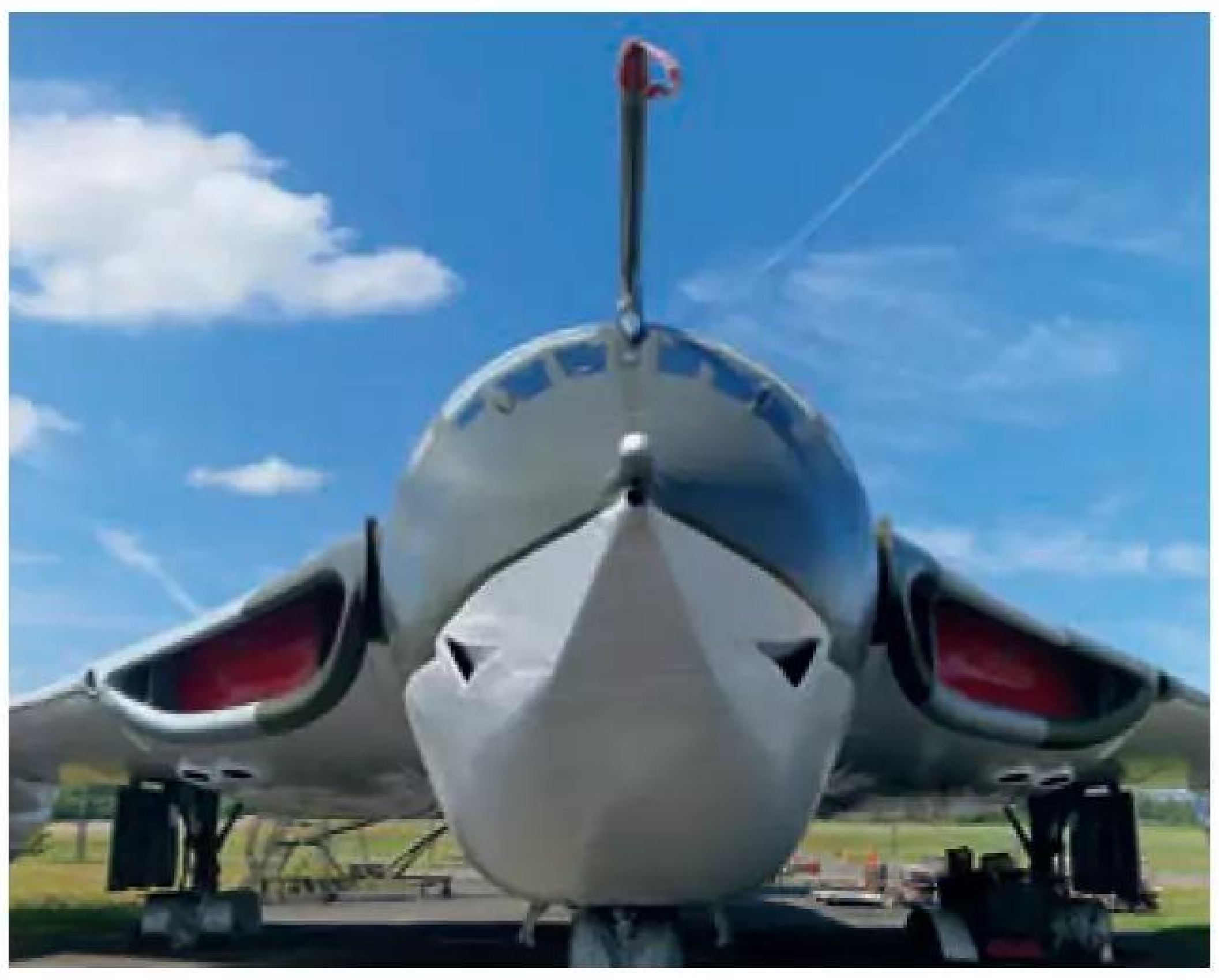
News

GET IN TOUCH: If you are involved in an aircraft restoration or are acquiring a special aircraft linked to either the Second World War or Cold War and would like Aviation Classics Monthly to cover your progress, contact aviationclassics.ed@kelsey.co.uk

Victor 'Lusty Lindy' wows crowds with pristine camouflage repaint



A head-on look at XL231's new scheme. **Yorkshire Air Museum**

Yorkshire Air Museum's Falklands War veteran Handley Page Victor K.2 tanker XL231 'Lusty Lindy' has now been officially unveiled in the camouflage paint scheme it wore when based on Ascension Island in 1982.

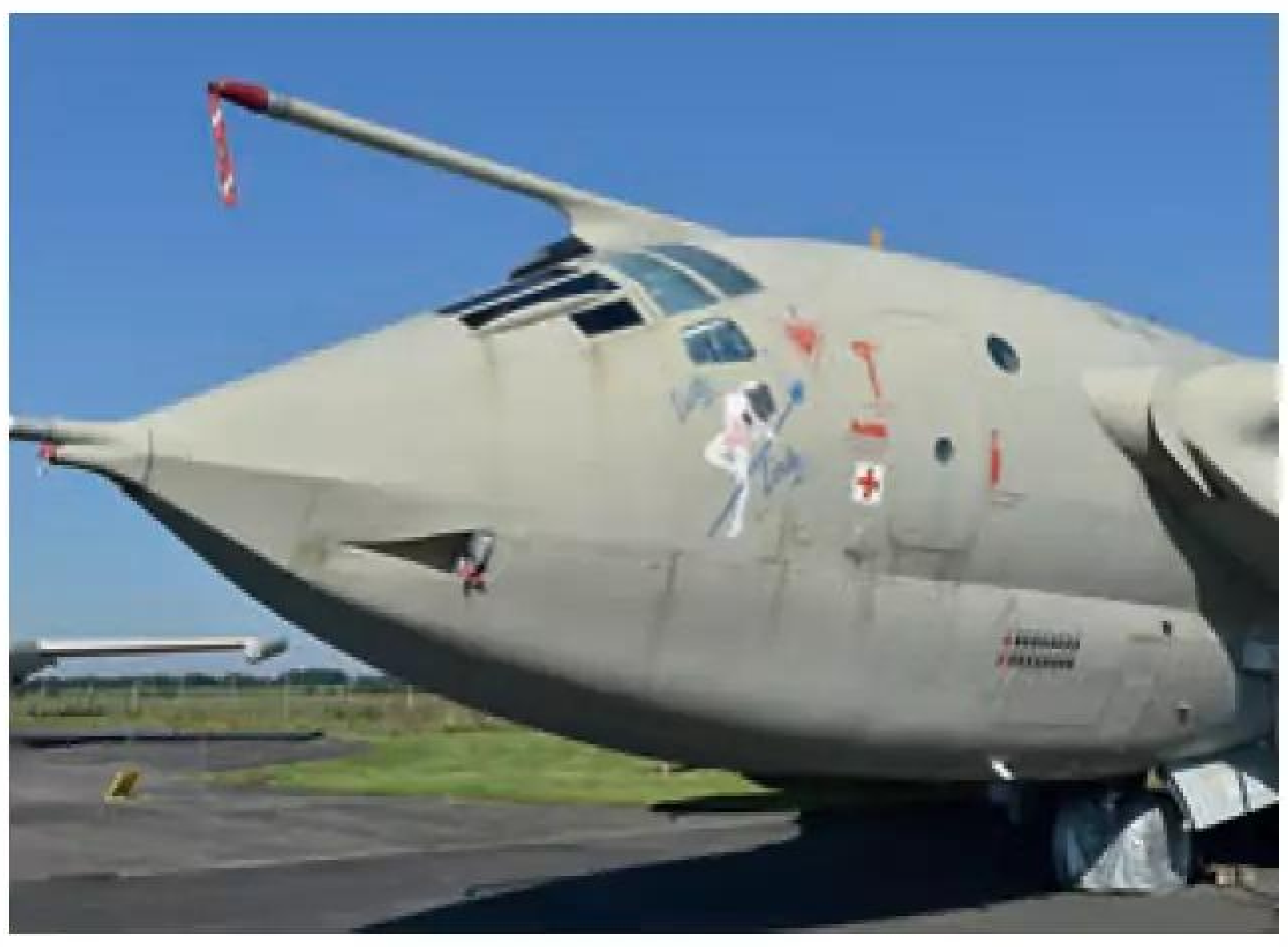
The repainting project began in May 2025, with the aircraft being swaddled in scaffolding and the painting carried out by specialists from York-based firm Bagnalls. To capture the transformation, Site Eye Ltd, of Hebden Bridge mounted a time-lapse camera on the museum's control tower. Over six weeks, it photographed the process every three minutes, ultimately producing a striking two-minute film that chronicles the restoration of XL231's early 80s look.

XL231 has been a permanent fixture at Yorkshire Air Museum since its arrival in 1993 when it sported the hemp-grey scheme it had worn during the first Gulf War.

The museum's marketing and communications manager Jerry Ibbotson said: "The repainting of Victor XL231 was a real team effort, involving staff, volunteers and outside contractors. The aircraft looks amazing, a few visitors have even asked if it's a new acquisition, when in fact it's been here for 32 years."

XL231 was first flown on December 28, 1961, and entered service with 139 Squadron at RAF Wittering on January 31, 1962, in the conventional bomber role. In November 1963, the aircraft was returned to Handley Page for an upgrade which enabled it to carry the Blue Steel stand-off missile. Returned to Wittering on July 17, 1964, it continued to fly with 139 Squadron until the unit was disbanded in 1968.

A transfer to Handley Page followed and in April 1970 XL231 became the K.2 development aircraft – undergoing many modifications and not flying again until March 1, 1972. The following two years were spent carrying out development trials with the A&AEE at Boscombe Down, returning to Woodford in 1974 for additional work which would see the aircraft finally kitted out for life as a standard K.2 tanker.

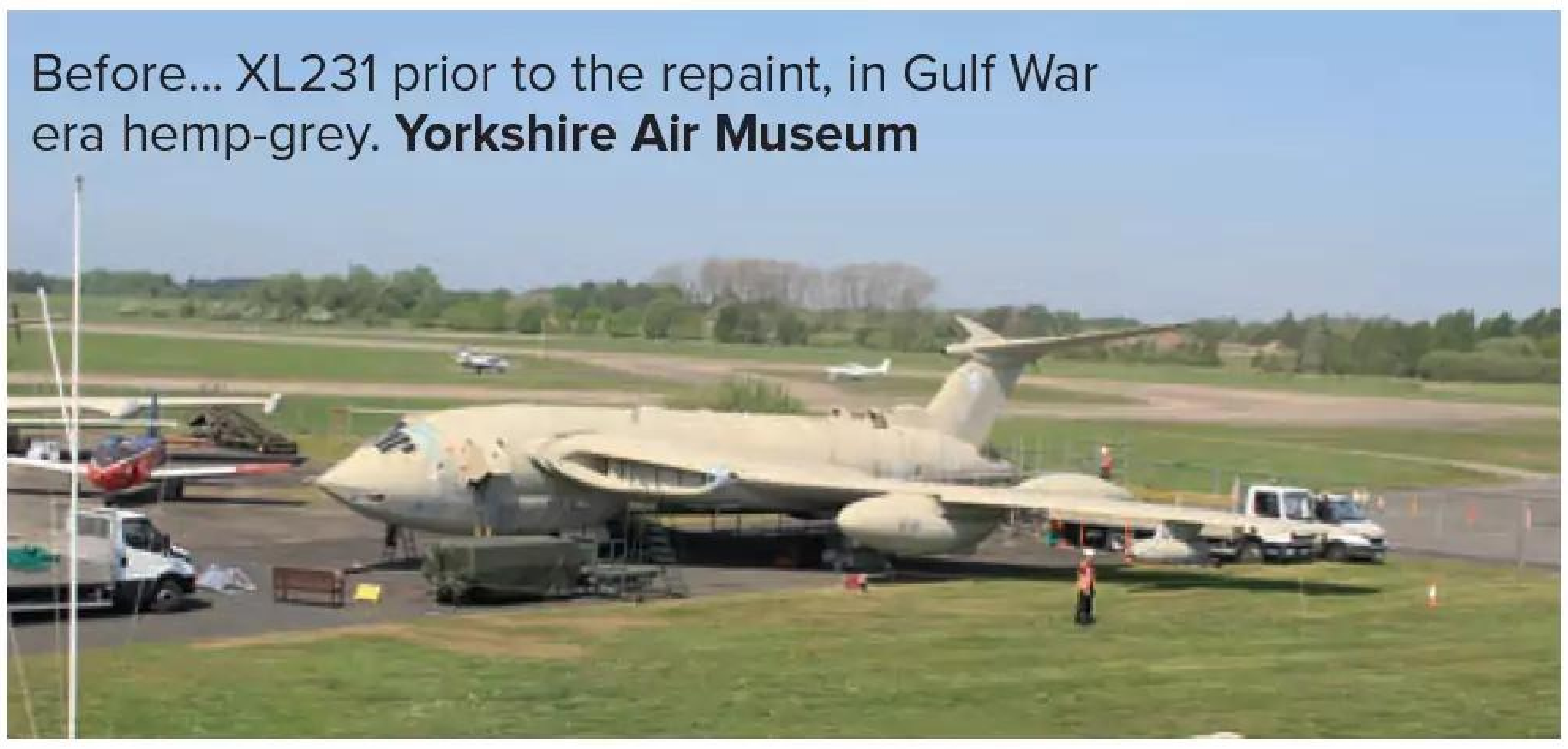


Distinctive Gulf War-era nose art, pre-repaint. **Alan Wilson**

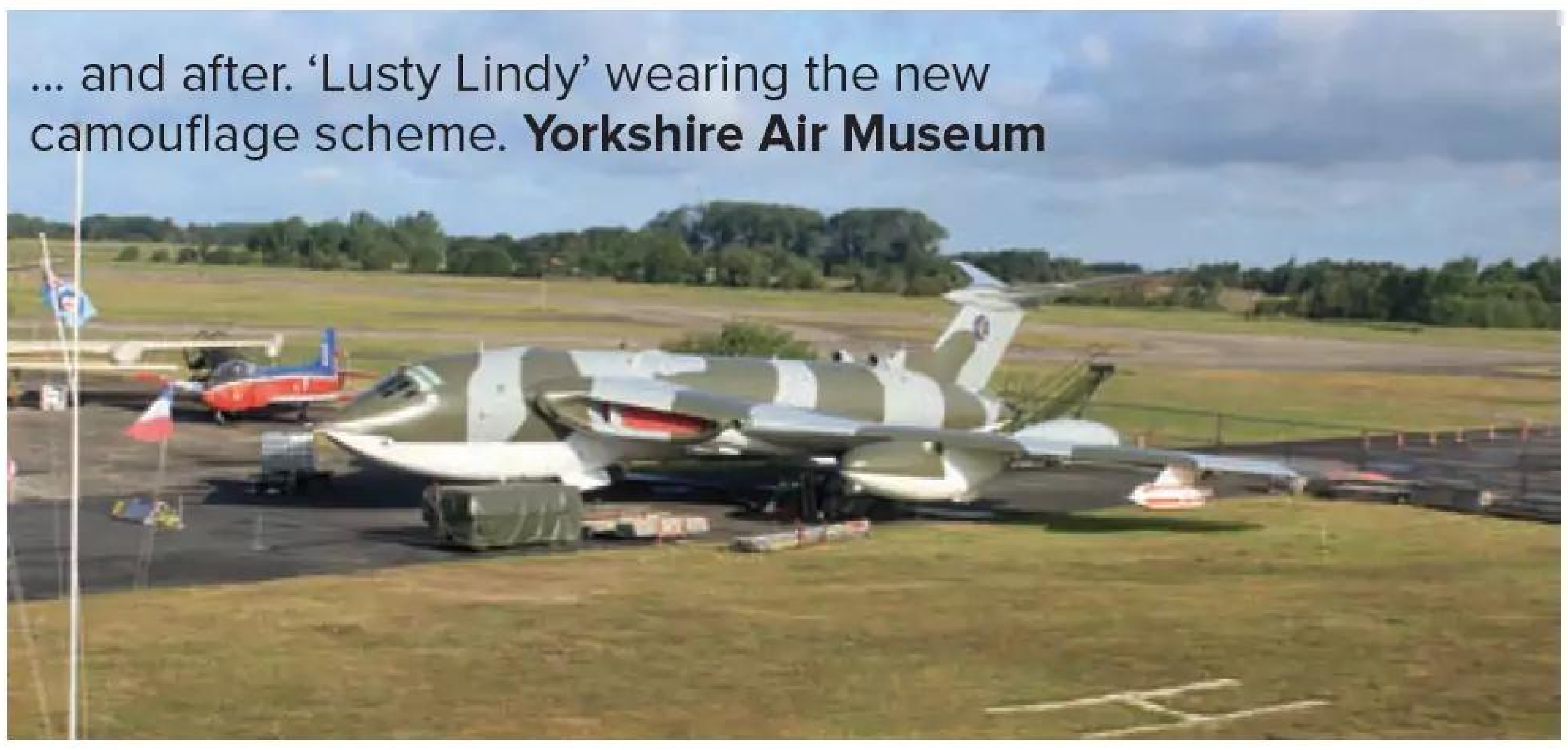
XL231 then joined 57 Squadron at Marham on July 8, 1977, and in 1982 it was heavily involved in the Falklands War build-up, helping to train Nimrod, Vulcan and Hercules crews in the delicate process of air-to-air refuelling, as well as supporting several Harriers on their way to Ascension Island.

Having flown in support of the Task Force, it was moved to 55 Squadron in July 1985 before returning to 57 Squadron prior to their disbandment in June 1986. Back with 55 Squadron, XL231 then flew in support of RAF forces during Operation Granby – the first Gulf War – in 1990/91. It was finally retired on October 15, 1993, and its last flight, to Elvington, was on November 25, 1993.

The new paintjob was completed in June with the official unveiling taking place at the museum's Victor Day 2025 event on August 28.



Before... XL231 prior to the repaint, in Gulf War era hemp-grey. **Yorkshire Air Museum**



... and after. 'Lusty Lindy' wearing the new camouflage scheme. **Yorkshire Air Museum**

Dakota flypast to mark doomed airborne assault anniversary

The BBMF's C-47 regularly flies alongside aircraft from private collections for the Arnhem anniversary.. **Picture BBMF**

At least two C-47 Dakotas were expected to perform a flypast marking the 81st anniversary of Operation Market Garden over the weekend of September 19-21.

Paratroopers will jump from the aircraft above Ginkel Heath, near the Dutch town of Ede, on Saturday, September 20, ahead of memorial service, with further services to be held on the Sunday. In 2024, the Aero Legends aviation company mounted parachute displays with the Round Canopy Parachuting Team.

It is understood that around 20 C-47/DC-3 airframes are still airworthy across the globe today with as many as 300 on static display in museums and others deployed as gate guardians such as C-47 KP208 at 16 Air Assault Brigade's Merville Barracks in Colchester.

ZA947, the Battle of Britain Memorial Flight's aircraft, based at RAF Coningsby in Lincolnshire, is also expected to be displayed over Holland during the event. The 76-year-old transport aircraft had previously served with the Defence Research Agency, latterly at Farnborough in Hampshire with the Royal Aircraft Establishment and was taken on charge in 1992 when it became surplus to the agency's requirements. The aircraft was adopted by RAF Strike Command and assigned to the BBMF.

The commercial aviation company Aero Legends also operates a Dakota which has flown at Arnhem and other commemorative events. The Legends C-47 was delivered to the United States Army Air Force on December 28, 1943, and took part in the first wave of the airborne assault in Normandy on June 6, 1944, dropping 18 paratroopers of the 82nd Airborne Division near St Mere Église in France. In September 1944, it was transferred to the RAF and assigned to Number 1 Heavy Glider Servicing Unit, attached to 38 Group RAF at Nether Avon, Wiltshire. The aircraft actually took part in Operation Market Garden as well, being later transferred to the Royal Canadian Air Force.

Operation Market Garden – a heroic failure

The ambitious objective of Operation Market Garden, September 17-25, 1944, was to break into Germany by seizing key bridges in the Netherlands. It involved airborne troops from the US 101st and 82nd, as well as the British 1st Airborne Division, dropping behind enemy lines to capture the bridges while a ground assault by the British XXX Corps advanced north to link up with them. Early gains were made, but delays, strong German resistance, and failure to secure the Arnhem bridge led to the operation's collapse. It ended in Allied withdrawal, heavy casualties – especially for the British 1st Airborne – and only limited territorial gains. The operation later gave rise to the idiom 'a bridge too far'.

‘Spooky’ tribute making progress

The American Flight Museum’s AC-47 tribute shows how the completed CAF Gulf Coast Wing aircraft could look. **DPL**

The team restoring a flying tribute to the AC-47 ‘Spooky’ gunships that served during the Vietnam War say only a few further steps are needed before the aircraft’s annual inspection can be completed.

The Commemorative Air Force Gulf Coast Wing, based at Conroe/North Houston Regional Airport in Texas, acquired C-47B-15BK Skytrain 43-49297 in May last year and a maintenance team known as the Ghostbusters has been working on its restoration ever since.

The aircraft initially served with the USAAF before transitioning to the US Navy as R4D-6 BuNo 50788 and then passing through various US government agencies before being sold into civilian hands in 1984. The aircraft was first painted as an AC-47 in 2007, bearing the three-digit serial number 086 in tribute to the 86 men who died on AC-47s in the 4th Special Ops Squadron.

CAF Gulf Coast Wing has said its two main goals are the complete the annual inspection and to carry out the modifications needed to convert the C-47 to the AC-47 configuration for the first time. Although a planned full repaint has been postponed, the team has been working to install the AC-47 astrodome and cockpit escape hatch, the latter commonly known as the ‘hamburger door’.

They have also been strengthening ties with the Spooky Brotherhood, a veterans’ association of aircrew and maintainers who served with AC-47s in Vietnam. Eight members of the Wing were planning to attend the Spooky Brotherhood’s scheduled reunion in Dayton, Ohio, in late September 2025.

Flying WW1 bomber yours… for £1.6m

Airco DH.9 E8894 pictured at Duxford prior to its first flight in restoration. **Alan Wilson**

The only original World War I bomber still capable of flying has been listed for sale with a £1.6m price tag.

The Airco DH.9 was a British biplane bomber powered by a single 200bhp Siddeley-Deasy Puma and was developed and deployed on the Western Front in 1918. More than 2,000 were built and this particular example, serial E8894, was donated to India in 1919 under the Imperial Gift Scheme and was one of two eventually rediscovered dismantled in a former elephant shed at Junagarh Fort, Bikaner, Rajasthan, in the late 1990s. Recovered and fully restored, it finally flew again in May 2019.

E8894’s counterpart, D5649, was restored to a non-flying condition and is now on display in the Imperial War Museum’s Airspace hangar at IWM Duxford in Cambridgeshire.

The sale is being administered by US-based broker Platinum Fighter Sales. For more information visit www.platinumfighters.com

Lightning XP706 gets missile pack

A project to restore Lightning F.3 XP706 at South Yorkshire Aircraft Museum is reportedly advancing rapidly – with the most recent work including the restoration and fitting of the missile pack to the underside of the fuselage.

Work on XP706 began during the autumn of 2020 and has made excellent progress. According to the museum: “Our team of volunteers have successfully restored and fitted both the No.1 engine door and missile pack, meaning the underside of the aircraft is now closed for the first time in over a decade.

“Work has also been continuing on the belly tank, and this is now ready for fitting after the fuselage surfaces have been prepared and painted before they are covered by the tank. Work has also continued on the cockpit equipment, with the radar controller now restored and looking fresh from the factory! Work is already well underway for the next milestone in the project, and let’s just say it’ll be a ‘wheel-y’ big one.”

For further information visit www.southyorkshireaircraftmuseum.org.uk

Barracuda build to get 'instruction manual'

Efforts to restore a Fairey Barracuda wreck to display condition will be aided by the discovery of archival materials and a £50,000 grant. **Royal Navy**

Efforts to restore a wrecked WW2 torpedo bomber rescued from a Northern Irish bog 54 years ago have been given a £50,000 funding boost.

Fairey Barracuda Mk II DP872 was built by Boulton Paul in July 1943 and served with 769 NAS, a carrier landing training squadron. On August 29, 1944, the aircraft span into Blackhead Moss near Enagh Lough, Waterside, Londonderry, during a transfer flight and all three crew were killed. The aircraft then sank before they could be recovered.

However, in 1971 a combined team from RNAS Yeovilton and 63 HQ Sqn RE salvaged the wreck; the crew were buried and the aircraft's remains were moved to the store of the Fleet Air Arm Museum. Since then efforts have been underway to rebuild and restore the aircraft, which is the most complete survivor of its type.

The cash grant, from the Archives Revealed partnership, will pay for work to catalogue a treasure trove of recently rediscovered Fairey Aviation archives and recover any relevant blueprints, technical drawings and test reports which could aid the restoration.

Over the last five decades, components from other wrecks (LS931, DR306, MD956 and PM870) have been assembled but putting everything together has proven to be a significant challenge.

Louisa Blight, Head of Collections and Research at the National Museum of the Royal Navy, said: "For a long time, the Barracuda project has felt like building a life-sized Airfix model – but this funding gives us the 'instruction manual' we've been missing."

Just Jane's rear now ready for reassembly

Primary structural work on the rear fuselage of Avro Lancaster NX611 'Just Jane' has now been completed and it has been removed from its jig – ready for final internal assembly.

Since 2016, Just Jane, based at the Lincolnshire Aviation Heritage Centre in East Kirkby, Lincolnshire, has been undergoing a rolling programme of restoration where a different job is tackled every winter. During the summer, the aircraft is the centre's star attraction and carries out taxi runs for paying visitors.

During the winter of 2022, Just Jane's own rear fuselage was removed for restoration and replaced with that of a donor – KB976. Now the former has been made structurally sound and will be refitted with its internal parts, including ammunition tracking for the rear turret, draft doors, fire axes and oxygen bottle holders.

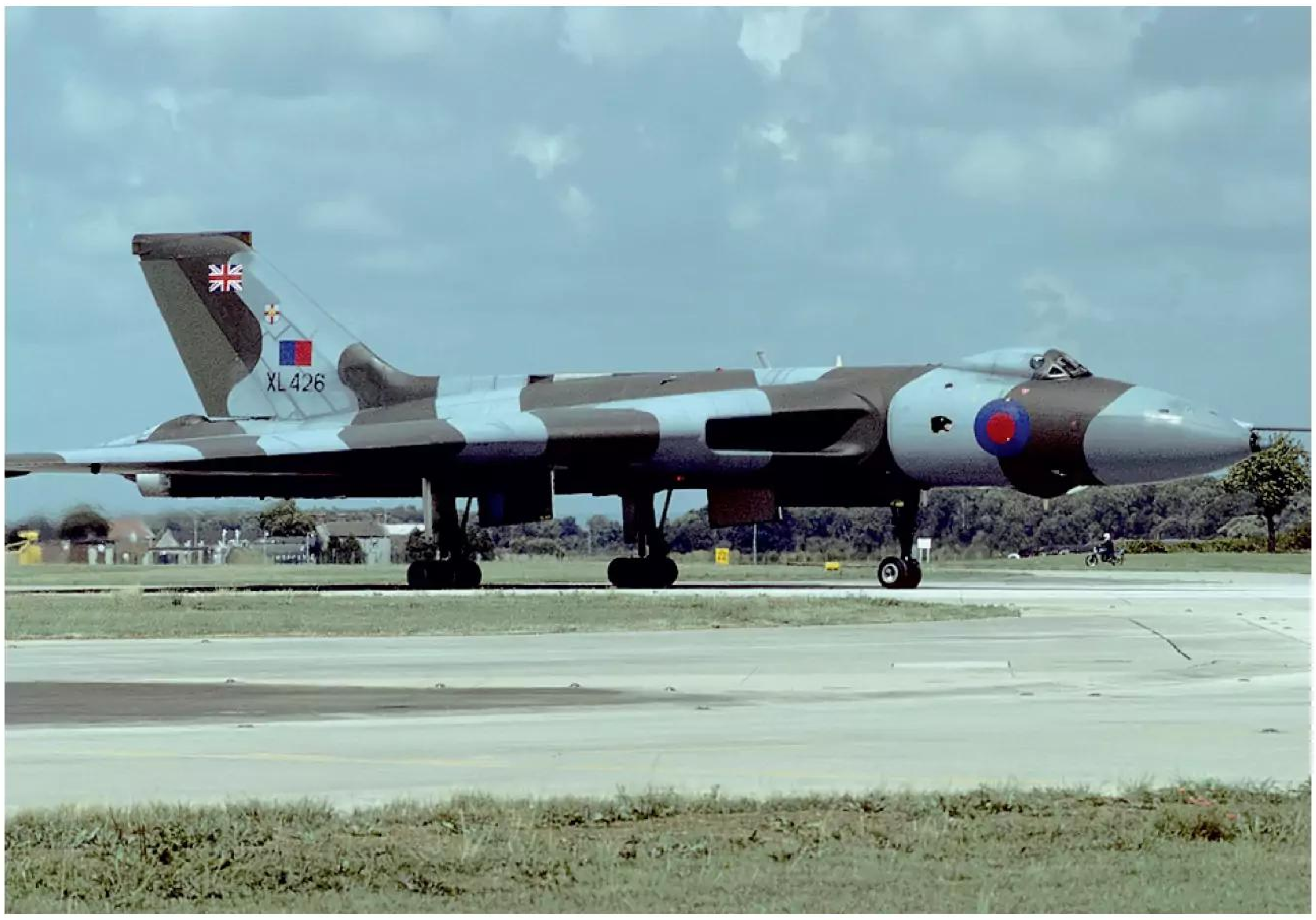
Work on NX611's tailplanes has also progressed. Team members Keith, Chris, Jodie, and Josh have carefully removed skins, stringers, and ribs from the tailplane structures. Front spars were temporarily supported on the jig prior to removal, enabling detailed inspection and paint stripping of the components. While some ribs sustained damage from exposure at RAF Scampton, the majority of fittings remain reusable. New build ribs are being trimmed to match the originals, preparing them for assembly into the restored tailplanes.

The mid-upper turret cupola also required attention after damage. Thanks to foresight in acquiring another FN150 turret project 15 years ago, a restored cupola from that project has been temporarily installed on NX611 while the original is repaired. Progress has also been made on engine bearers and the aircraft's flap tubes, which are being produced in a £160,000 project by specialists Retro Track and Air. The complex assembly includes steel tubes with cast parts riveted internally and is expected to be completed by January 2026, providing airworthy flap tubes for NX611's wings and centre section.

Meanwhile, the jig vacated by NX611's rear fuselage will now be extended and prepared to accept the rear-mid fuselage of NX664, a Lancaster built by Austin Motors in Longbridge and delivered to the French air force in August 1952 for use in the search and rescue role. The goal is to return NX664 to taxiable condition.

The original rear fuselage of Avro Lancaster NX611 'Just Jane' is now ready for reassembly. **Alan Wilson**

Take a tour inside Vulcan XL426



Avro Vulcan XL426 pictured at Yeovilton on August 3, 1984. Mike Freer – Touchdown-aviation

Visitors will be able to climb aboard Avro Vulcan XL426 and take a look around – for a small fee – during Visit the Vulcan Day at London Southend Airport on Sunday, September 28.

The Vulcan Restoration Trust event includes a display showcasing examples of the weapons carried by the Vulcan during its time with the RAF, including the type of 1,000lb high explosive bomb dropped on Port Stanley airfield during the 1982 Falklands Conflict.

XL426 is one of the best-preserved Vulcans in existence today and regularly performs high-speed taxi runs at Southend.

Other displays lined up for Visit the Vulcan Day include military Land Rovers, British Army tanks and armoured vehicles, Shoeburyness & South Essex Royal Artillery Association, 10th Essex Living History Group, Great War Living History Group, South Eastern Vintage & Classic Car Club, Essex Mini Owners Club, Southend Radio Control Model Flying Club and a selection of historic fire engines.

Refreshments will be available as well as a host of Vulcan souvenirs.

Admission is £8 for adults with under-16s admitted free. XL426 cockpit visits cost an additional £8 per person applicable to both adults and under-16s. They will take place every 15 minutes on a timed ticket basis, so there will be no need to stand and queue.

According to the Trust: "Cockpit visit tickets are subject to availability and will only be on sale on the day. When they're gone, they're gone! Children must be over 1m tall to visit the cockpit and must climb the entry ladder themselves (no carrying)."

Gates open at 10am with last admission at 4pm.

For more details visit https://avrovulcan.com

Cold War Jump Jet joins US museum

The Tillamook Air Museum in Oregon has taken delivery of an AV-8B Harrier II as the last in-service derivatives of the famous British design finally enter retirement. **Picture US Navy**

With the US Marine Corps, one of the last operators of the venerable Harrier, winding down its AV-8B fleet ahead of full retirement in 2027, a few examples have been making their way to air museums.

The Tillamook Air Museum in Oregon has just taken delivery of one long-serving Harrier II, BuNo 165002, from Naval Air Weapons Station China Lake.

Pilot James Coppersmith flew the aircraft directly to Oregon from China Lake, a key US Navy research and test facility located in California's Mojave Desert, in August. It is being provided on extended loan in an agreement with the National Naval Aviation Museum in Pensacola, Florida.

The aircraft – which has logged 5,518 total flight hours, including 631 combat hours flown across 88 missions and completed 5,457 landings over its 30-year career – will be demilitarised and prepared for permanent exhibition at the museum.

"This aircraft is as capable as they've ever been," said James, a 24-year Marine Corps veteran, "and today was its last flight ever. It seems kind of sad but at the same time, you know, a great museum, a great community's getting a forever jet".

The Harrier II is the McDonnell Douglas redevelopment of the original Hawker Siddeley Harrier featuring a larger composite wing with an additional hard point on each side, an elevated cockpit, a redesigned fuselage and other structural and aerodynamic refinements, not to mention a more powerful engine. The AV-8B made its first flight in November 1981 and entered service with the Marine Corps in January 1985.

B-52's new look

The B-52 entered service as a strategic bomber to carry American's nuclear weapons during the Cold War. Many D models were retired and employed as gate guardians – the B-52 H remains operational. **DPL**

A B-52 Stratofortress bomber which once stood outside Castle Air Force base in California's Central Valley and is now on show at Castle Air Museum has been restored to its original paint colour.

Castle Air Force Base served as a hub for Boeing B-52 Stratofortress bombers assigned to the US West Coast to serve as a key component in the United States' nuclear defence system during the Cold War. Although Castle AFB has been deactivated since 1995 and turned into the Merced-Castle Airport, one B-52 remains on display at the Castle Air Museum.

But decades of outdoor display have taken their toll on the aircraft, which is now being completely repainted by a team of volunteers to return the aircraft to its former glory. The Castle Air Museum B-52 was originally constructed by Boeing's Seattle plant in 1957 as a B-52D model, with the construction number 17295.

On September 26, 1957, the aircraft was accepted into the United States Air Force's inventory as serial number 56-0612 and subsequently assigned to the 28th Bombardment Wing at Ellsworth Air Force Base, South Dakota. From April 1960 to April 1966, the aircraft was operated out of Sheppard Air Force Base, Texas, first with the 4245th Strategic Wing, then with the 494th Bomb Wing before the B-52 was transferred to the 509th Bomb Wing at Pease AFB (now Pease Air National Guard Base/Portsmouth International Airport), New Hampshire.

Its subsequent assignments were at Fairchild AFB, Washington, Westover AFB, Massachusetts, Dyess AFB, Texas, Ellsworth AFB, South Dakota, and Carswell AFB, Texas, before being briefly assigned to the 93rd Bombardment Wing at Castle Air Force Base from July 31, 1971, to June 26, 1972, before returning to the 7th Bombardment Wing at Carswell AFB.

Many of the wings 56-0612 served with had sent their complement of B-52s to combat deployments during the Vietnam War, flying long-range missions primarily from Andersen Air Force Base on Guam. In fact, the aircraft was officially transferred to Andersen AFB when it was attached to the 43rd Strategic Wing on February 21, 1974, before being officially assigned to the 307th Strategic Wing at U-Tapao Royal Thai Navy Airfield in Thailand from March to September 1974 and later made its way back to the continental US via Andersen air base.

By the start of the 1980s, the B-52Ds were being retired from service, and 56-0612 was serving with the 22nd Bomb Wing at March Air Force Base (now March Air Reserve Base) in Riverside, California. Around this time, local aviation enthusiasts had established the Castle Air Museum at Castle AFB in Atwater, with active-duty personnel at the base spending much of their free time assisting the museum in gaining new acquisitions. One of these would become 56-0612, which was flown in from March AFB in 1982 and officially stricken from the USAF's inventory to be placed on permanent display at Castle. Moving the bomber even required the vertical stabilizer to be removed and strapped over the horizontal stabilizer to fit under the base's power lines. Additionally, an AGM-28 Hound Dog cruise missile was fitted to the left wing of 56-0612 at the Castle Air Museum.

As the base itself was deactivated in 1995 following the end of the Cold War, the Castle Air Museum remained and expanded. However, being primarily an outdoor aviation museum, time and the elements always take a toll on the aircraft, requiring constant maintenance to be in display quality.

NEWS IN BRIEF

Mission to restore crashed Halifax

A Canadian salvage project is seeking financial support to recover and restore a Halifax bomber which ditched off the Swedish coast on August 8, 1943.

The Royal Canadian Air Force (RCAF) bomber, serial number HR871, crashed after its seven crew members bailed out. For nearly 73 years, the aircraft lay hidden in just 50 feet of water in southern Sweden – until its rediscovery a decade ago.

Now, the Halifax 57 Rescue group, in partnership with a team at Lund, has secured official Swedish government approval to salvage the bomber. The organisation is calling on Canadians and aviation history supporters worldwide to help fund the recovery and return of HR871 to Canada, preserving a remarkable piece of wartime heritage.

The project is expected to take significant period of time with the team hoping that the airframe can be recovered from the water in one piece.

A Halifax bomber in flight during the war. A team is now hoping to restore one.

B-25 Yellow Rose

North American B-25 Mitchell 'Yellow Rose' will be on display with the B-29 DOC at the B-29 DOC Hangar in Wichita from August 19-26, 2025.

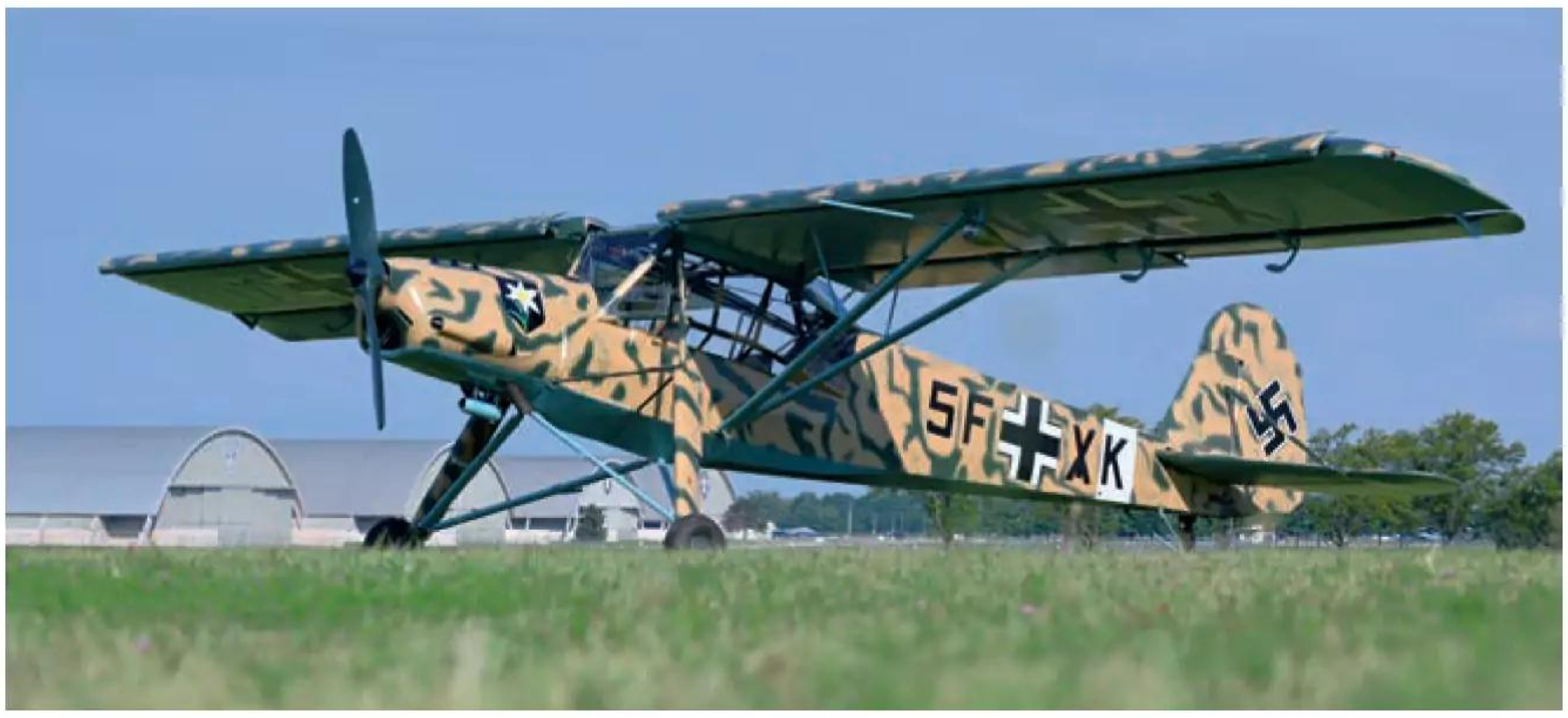
Together, the two legendary warbirds highlight the story of World War 2, from the Doolittle Raid to the final missions that ended the war. The iconic B-25 Mitchell bomber Yellow Rose has gone on static display alongside the B-29 DOC at Education and Visitors Centre in Wichita. Operated by the Commemorative Air Force Central Texas Wing in San Marcos, Texas, Yellow Rose shares a powerful historical connection with the B-29.

The B-25 gained fame as the aircraft used by the Doolittle Raiders in 1942, marking the first US air attack on mainland Japan during World War 2. Just three years later, the B-29 played a pivotal role in the war's closing chapters, delivering the final missions that led to Japan's surrender on September 2, 1945.

Tornado Gate Guardian

A former RAF Tornado has been unveiled as RAF Honington's new gate guardian as it replaces a Blackburn Buccaneer which has been transported to Binbrook in Lincolnshire where it will be put on show in due course. The Tornado continues to wear the camouflage scheme warm by the aircraft when entering service in 1980. Tornado ZG752 was delivered to the RAF as a GR 1 in 1991 and converted to GR4 status.

Storch gets Rommel's desert colour in 18-month makeover



The National Museum of the US Air Force has returned its Fieseler Fi 156 C-2 Storch to display following an 18-month restoration project. **USAF**

The National Museum of the USAF has returned its Fieseler Fi 156 C-2 Storch to display following an 18-month restoration project.

Painted in the colours of the aircraft once flown by Field Marshal Erwin Rommel, the Storch now features a meticulously researched desert camouflage scheme, complete with historically accurate markings and details.

The aircraft was removed from public view in 2016 to make room for the famous 'Memphis Belle' B-17. Disassembly began in early 2024, with the restoration team starting the livery later that spring. The Storch was repainted in markings seen in archival German photographs of one used by Rommel between 1941 and 1943.

The restorers found that the Storch's original cotton fabric covering was in dilapidated condition having remained on the aircraft for decades; its original installation date being unknown. Once that had been removed, the airframe was thoroughly inspected and showed no major signs of corrosion in its metal or wooden struts. The tubular steel frame was covered in multiple layers of old paint that required careful removal.

While the restoration team initially planned to keep the engine attached during this process, it was ultimately removed to facilitate transport to a local shop for stripping. For preservation, a synthetic poly-based fabric was applied in place of natural fibres, which are prone to deterioration even in climate-controlled environments. The new covering will ensure the restoration endures for decades to come.

Once again using archive photographs for reference, the team meticulously painted the aircraft to replicate a wartime appearance. One particularly intriguing feature was the fuselage and wing identification markings. Additional touches include hand-painted cockpit markings, detailed instrumentation, and the distinctive edelweiss flower painted on the nose over the desert camouflage pattern.

MiG-21 Fishbed going public at Edwards AFB

The Flight Test Museum at Edwards Air Force Base in California, has announced their acquisition of an ex-Polish Mikoyan-Gurevich MiG-21. The aircraft type which had the NATO codename 'Fishbed', has been brought from its long-time home at Santa Maria, California to Edwards Air Base, where it will eventually go on display in the new museum site near the West Gate of Edwards.

This particular MiG-21 is a MiG-21PF, known by NATO as a Fishbed-D, that was built with the construction number 761811 and was flown in the service of the Polish Air Force from June 1965 to March 1989 until it was reassigned to be a ground trainer at Bydgoszcz Air Base.

Like many member states of the Warsaw Pact that disbanded their communist governments in the late 1980s and early 1990s, Poland now had a surplus of Cold War military equipment that it no longer needed, but found that many pilots, museums, and private collectors in the West were willing to purchase surplus MiGs from the former Eastern Bloc. As such, MiG-21PF s/n 1811 was sold to businessman Dave Baskett in June 1991 and was issued the FAA registration N21PF.

It was first seen in the United States at Mojave Air and Spaceport in 1992 but was later transferred to Santa Maria Public Airport. The aircraft was kept in a private hangar at the airport, but made occasional public appearances, such as being displayed at the Santa Maria Museum of Flight and placed on the flight apron during air shows held at the airport.

The Flight Test Museum at Edwards AFB in California, has announced their acquisition of a MiG-21 Fishbed. **FTM**

When the aircraft was offered to the Flight Test Museum, the aircraft was still in airworthy condition, except for the afterburner. Instead of being flown to Edwards Air Base, a team of volunteers drove out to Santa Maria Airport, disassembled the aircraft, and trucked it to Edwards, where it has since been reassembled in a storage hangar. The museum has also stated that they will be repainting the aircraft before it goes on display at some point in the the next 12 months.

Ex-Peruvian Thunderbolt gets extensive structural repairs

An ex-Peruvian Air Force P-47D, now with the American Heritage Museum, is undergoing a full restoration at American Aero Services in Florida. **DoD**

The American Heritage Museum's Republic P-47D Thunderbolt, which was built in 1945 and once served with the Peruvian Air Force, is undergoing a full restoration at American Aero Services in Florida.

The project has uncovered a unique piece of history – a hidden 1944 signature from Republic Aircraft worker Mary Edith Tharp – linking the aircraft directly to the 'Rosie the Riveter' legacy.

Built at Republic's Evansville, Indiana plant as a P-47D-40-RA, the aircraft was accepted into US Army Air Forces service on May 29, 1945, as serial number 45-49167. Following its acceptance, the Thunderbolt served at various bases in Texas, Kansas, and Oklahoma. In 1952, it was transferred to TEMCO Aircraft in Dallas, Texas, under the Reimbursable Aid Program as a test airframe at Hensley Field (now Grand Prairie Armed Forces Reserve Complex). Its final USAF posting was with the Caribbean Air Command at Albrook air base in the Panama Canal Zone.

On March 16, 1953, it was officially retired from service with the US military and reassigned to the Fuerza Aérea del Perú (Peruvian Air Force) as FAP 540. Later re-serialled as FAPe 116, the aircraft was placed into storage.

Later, the National Museum of USAF carried out a cosmetic restoration and repainted the aircraft as 'Five by Five'. replicating the P-47 flown by Colonel Joe Laughlin, commanding officer of the 362nd Fighter Group, 9th Air Force, in 1944. In recent years, however, disassembly revealed that the fuselage and wing structures required significant restoration to make the aircraft airworthy once again. The Thunderbolt is now undergoing a full restoration to flight by American Aero Services in New Smyrna Beach, Florida, under project manager Ashley Ezell. The cockpit and internal fuselage have been stripped, cleaned, and treated for corrosion, with preservation efforts underway for original factory markings.

It was in February 2024, during disassembly, that a hidden bulkhead behind the pilot's seat was found to bear the handwritten name 'Sue Mary E Tharp,' untouched since the aircraft's production in 1944. An appeal to identify the signature led to the discovery that she was Mary Edith Tharp, a Republic Aircraft employee who worked on fuselage bulkheads and the turbosupercharger section. The identification came through her great-nephew, pilot Chad Halterman of Martinsville, Indiana, who recognised her name from social media posts. Tharp, who passed away in 2015 at age 91, was also an accomplished athlete for the Republic Raiderettes women's basketball team. Her family intends to donate her memorabilia to the American Heritage Museum.

Over the past year, the restoration team has carried out extensive structural repairs to the airframe and wings, reversing decades of wear from its Peruvian service and exposure to the elements during its time as an outdoor display in Florida in the 1970s. The next phase will involve rebuilding the turbosupercharger system and overhauling the Pratt & Whitney R-2800-59 engine.

Once complete, the P-47D will return to the American Heritage Museum, where it will serve as the main exhibit in a planned aviation wing expansion.

Liberator moved to Georgia

A rare Consolidated B-24 Liberator is to go on show at the United States National Museum of the Mighty Eighth Air Force in Pooler, Georgia.

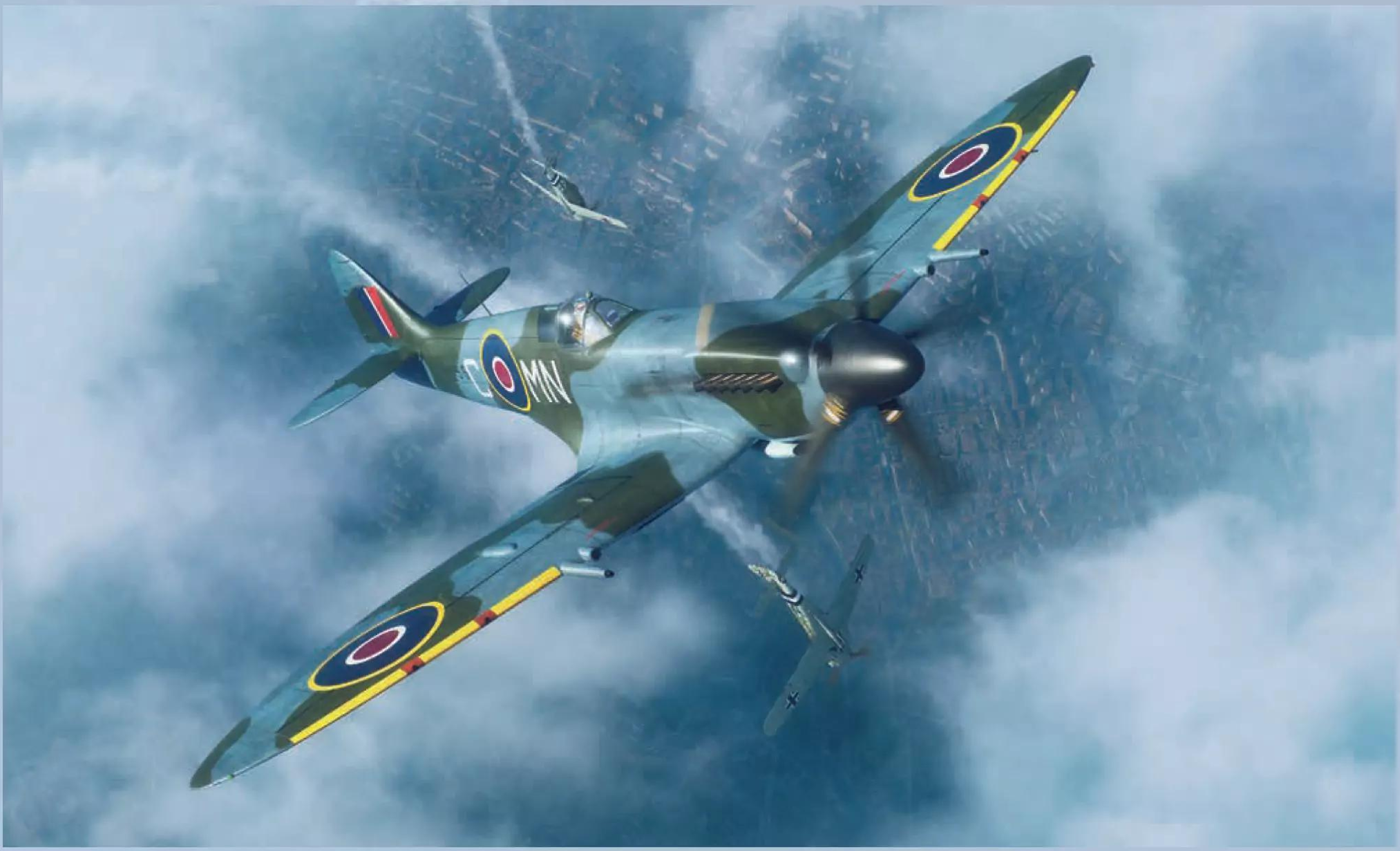
The aircraft, B-24J-20-FO, serial 44-48781, currently painted as 42-74076 'Rupert the Roo II' has been acquired by the museum from Barksdale Air Force Base.

Following its restoration, the B-24 will be centrepiece of a multi-million-dollar capital-improvement programme dubbed 'Maximum Effort'. The museum expansion and new permanent exhibitions are scheduled to be completed in late 2026.

Eighth Air Force and the Joint-Global Strike Operations Center commander Major General Jason Armagost said: "Our main priority is the preservation of the historic bomber, 'Rupert the Roo II'. By rehoming to the Mighty Eighth Museum, it will allow the artefact to be kept alive and well for generations – a gift made possible not only by the Air Force, but generous benefactors who understand the importance of WWII heritage."

44-48781 was built at Ford Willow Run and delivered in August 1944 before being struck off charge on December 7, 1945. It was then bought by Spartan School of Aeronautics, Tulsa, Oklahoma and used as an instructional airframe. Later stripped and left derelict, it was sold as scrap in 1960 and stored at Tulsa Airport. Purchased in 1978 by the National Museum of the United States Air Force, it was transferred to its current home at Barksdale AFB in December 1978. An initial restoration was completed in 1982, with the aircraft receiving the livery of 'Laden Maiden'. It was later painted as 'Louisiana Belle II'.

The B-24J Liberator at Barksdale AFB. **Michael Barera**



A fighter patrol from 350 Squadron encounters Fw 190s on the western fringe of Berlin as the battle for the city is raging. Watkins and his wingman are about to dive on four Fw 190s flying south below, but are then approached by two more Fw 190s. Watkins picks the one on the port side, makes a sharp turn to port, then gives it a quick burst of fire. He observes strikes on the starboard mainplane. The Fw 190 then rolls onto its back and Watkins hits it again in its belly. The Fw 190 turns into a tight spiral towards the ground then blows up. See pages 85-86 for full-sized artwork.

Spitfires *vs* Focke-Wulf Fw 190s

Seven Spitfires from 350 Squadron (Belgian), engaged in a fight with Fw 190s on the fringes of Berlin on April 20, 1945. The RAF was victorious, though one of their number failed to return…

It was approaching sunset on April 20, 1945, as seven 350 (Belgian) Squadron Supermarine Spitfire Mk.XIVs flew northwards on a fighter sweep around the western fringes of Berlin.

The Rolls-Royce Griffon-engined single-seaters passed Nauen at gone 7.20pm and continued northwards in the direction of Neuruppin. Smoke still lingered in the air following Eighth Air Force B-17 bombing raids on rail marshalling yards at both locations earlier in the day.

Not too far away, on the opposite side of Berlin, Russian units had crossed the River Oder and were advancing on the city. The following day, April 21, the German capital would be hit by Soviet artillery fire for the first time.

Within the centre of the city itself, in the Führerbunker, beside and beneath the Reichs Chancery, Hitler was making his final decision to stay in Berlin to the last – when his staff realised that the window of opportunity to escape by air or by road was rapidly closing.

The seven

The Spitfires flew in formation in two sections. Red section, and the mission, were being led by a 25-year-old Spaniard – Flight Lieutenant Robert 'Roberto' Muls in SM825 MN-M.

Muls, from Barcelona, joined the Belgian section of the RAF on June 10, 1942, before undergoing extensive training. After converting to the Spitfire in March 1944, he was posted to 350 Squadron, his first front line unit, on May 30, 1944. At the outset of

The leader of 350 Squadron's Red Section on April 20, 1945, and the mission leader, was Spanish Flight Lieutenant Robert 'Roberto' Muls. *via Serge Bonge*

> **"When in the Nauen area I saw four Fw 190s going in the opposite direction, south, below, but owing to the R/T being in use was unable to report them for the moment."**

the April 20 sweep, he had just one shared aerial victory – a Fw 190 shot down 15 days earlier over Aschendorf.

Red 2 was Belgian Pilot Officer Emile Pauwels, 24, in NH697 MN-K. He had been in Belgium when it finally capitulated to the Nazis on May 28, 1940, but escaped to England on May 15, 1942. After training, he joined 350 Squadron on July 27, 1944. On March 2, 1945, he was credited with damaging a Bf 109.

The third member of Muls' section, 25-year-old Flight Lieutenant David Howorth, was from Bolton, Lancashire, and flew RM618 MN-P. He became a sergeant in the RAF Reserve on July 27, 1940, and became a flying officer exactly a year later. He had no combat victories.

Red 4 was 22-year-old Warrant Officer Jacques 'Pichon' Groensteen (Pichon meaning young pigeon) who had fled Belgium as a refugee on May 20, 1940. He joined the Belgian Aircrew Receiving Centre in September 1941 and after training was posted to 350 Squadron on December 23, 1942. He then transferred to 349 Squadron on June 15, 1943, and more training followed until he was finally returned to 350 Squadron on January 10, 1945.

On March 2, 1945, he claimed a Bf 109 shot down in the Rheine-Munster area. On April 20 he was at the controls of NH686 MN-V.

Yellow section was led by Pilot Officer Desmond 'Des' Watkins, 23, from Llwyn-y-pia in the Rhondda Valley, south Wales, flying RB155 MN-C. Already an experienced pilot, Watkins had participated in the first Spitfire sortie over Germany with Squadron Leader Geoffrey Page and others on April 26, 1944. He had destroyed several enemy aircraft on the ground but had no air-to-air victories.

His No. 2 was Flight Sergeant Andre Kicq, 21, in RM733 MN-J. Like Pauwels, he had escaped occupied Belgium in 1942, before joining the RAF Volunteer Reserve in July 1942. Fully trained as pilot by August 1943, he was posted to 350 Squadron in July 1944. On April 17, 1945, he had achieved his first aerial victory by shooting down a Fw 190 south of Hamburg.

The seventh man, Yellow 3, was 26-year-old Pilot Officer Marcel Doncq flying NH693 MN-J. Of all the men, he had perhaps had the longest journey to reach the seat of his Spitfire XIV. He had been in the Belgian Army when war broke out and was captured by the Germans with his unit at Lombardsijde.

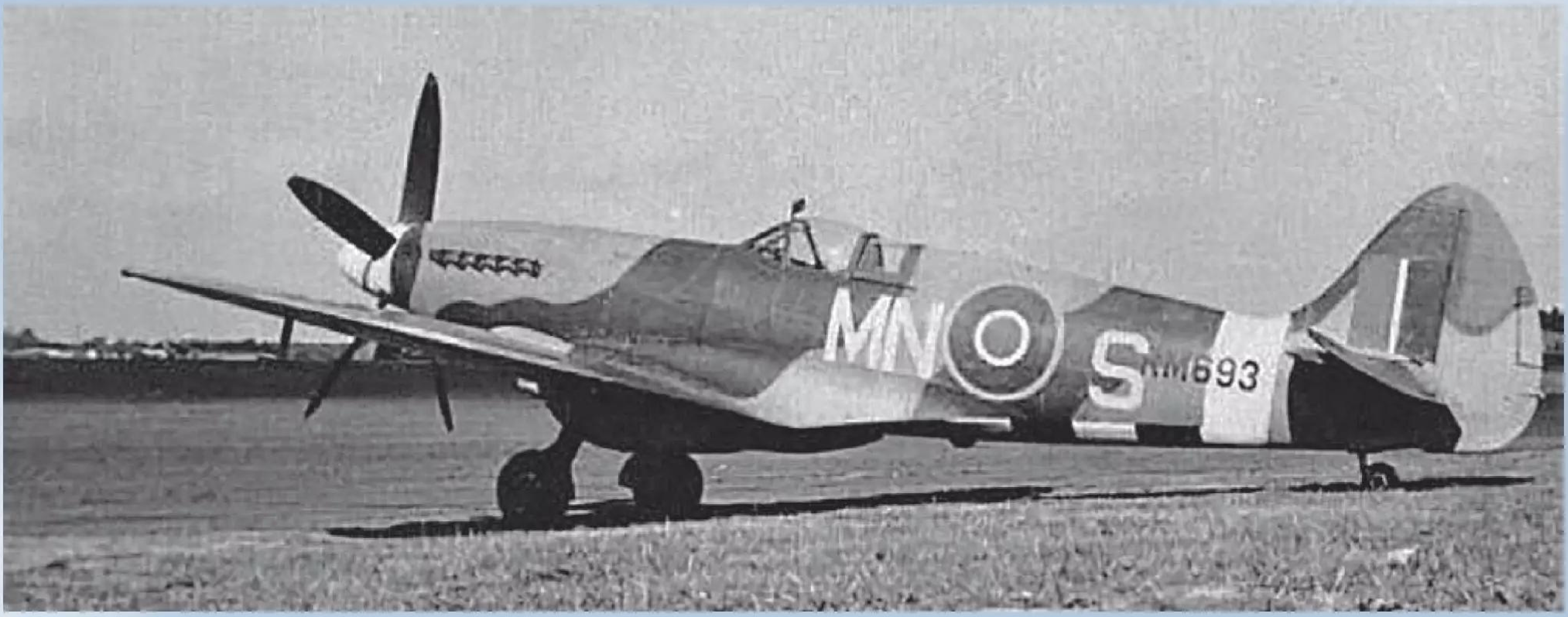
Escaping Belgium into France on April 16, 1941, he worked his way south across the whole of the occupied country, crossing into neutral Spain on April 25. Arrested near Barcelona by fascists, however, he was put in prison and languished in various cells for nearly a year.

Liberated on February 7, 1942, he reached Gibraltar on February 11, 1942. He was transferred to England on March 11, 1942, and he joined the RAF Volunteer Reserve. He was next sent to Canada for training and first flew solo in a Tiger Moth on March 4, 1943.

A year later he was back in Britain and had converted to the Spitfire. He joined 350 Squadron on June 12, 1944. By April 20, however, he had achieved no victories.

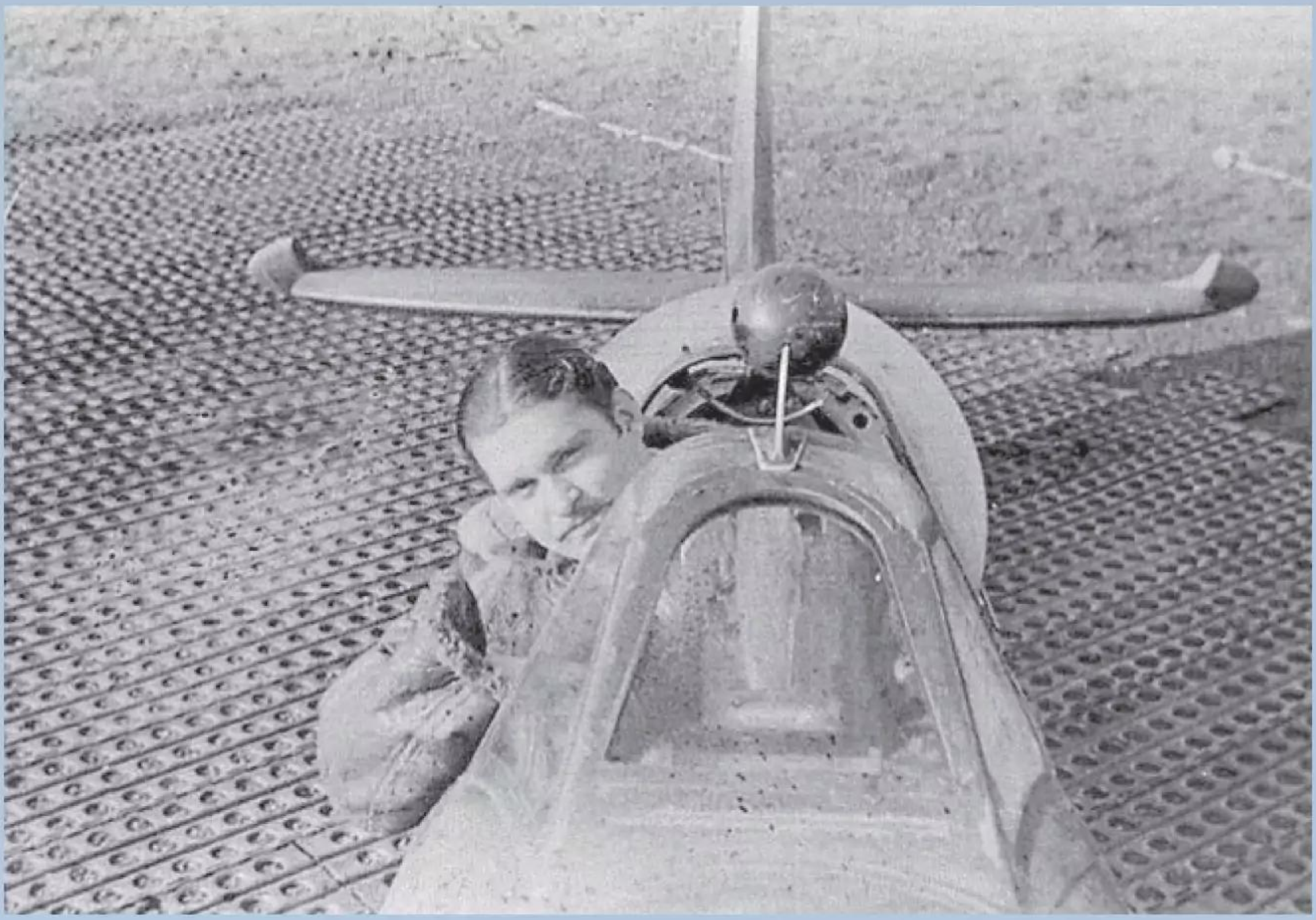
The battle

The seven Spitfires had set off from Advanced Landing Ground B.118 Celle in Lower Saxony, Germany, at 7.04pm with perhaps an hour and a half of daylight



A Spitfire Mk.XIV of 350 (Belgian) Squadron in 1944 – the following year noses of the unit's fighters were painted black and the tail stripes were removed.

Pilot Officer Emile Pauwels had escaped occupied Belgium in 1942 and signed up for the RAF as soon as he was able. During the combat on April 20 he stuck with Flt Lt David Howorth. *via Serge Bonge*



Flight Lieutenant David Howorth, from Bolton, Lancashire, became a sergeant in the RAF Reserve on July 27, 1940. He had no previous combat victories when he set off on the fighter sweep over the western fringes of Berlin on April 20. He died on February 21, 2016, and was buried at the Polson Cemetery, Point Vernon, Queensland, Australia. *via Serge Bonge*

still remaining. Celle, 175 miles from Berlin and formerly home to a Luftwaffe flying school, had only been captured from the Germans, largely intact, nine days earlier.

Half an hour later, the RAF aircraft had reached their target area and were flying in a north-easterly direction at 9000ft when Howorth saw something and within seconds all hell had broken loose.

According to his combat report: "When in the Nauen area I saw four Fw 190s going in the opposite direction, south, below, but owing to the R/T being in use was unable to report them for the moment."

When Howorth was finally able to report his sighting, Muls ordered Yellow section to attack.

Watkins reported: "Yellow 2 immediately went down and I was on the point of doing so when I noticed two Fw 190s coming towards me and my No. 3 slightly below us. I selected the one on the port side and made a sharp turn to port and gave a quick burst as the enemy aircraft was overshooting me.

"I observed strikes on starboard mainplane. The enemy aircraft then rolled on its back and in the process caught a long burst in its belly. The enemy aircraft turned into a tight spiral and spun towards the ground when I saw it blow up."

"The pilot of the Fw 190 left the cockpit but no parachute was seen to open. I was at about 8000ft. There being no more enemy aircraft I climbed above cloud (about 12,000ft) and rejoined the rest of the squadron."

Yellow 3, Doncq, wrote: "Yellow 2, F/Sgt Kicq, went down and we were about to follow him when we noticed two more coming towards us on a reciprocal course and slightly below. Yellow leader and I went in to the attack – the leader taking the enemy aircraft on his port side and I selected the other one.

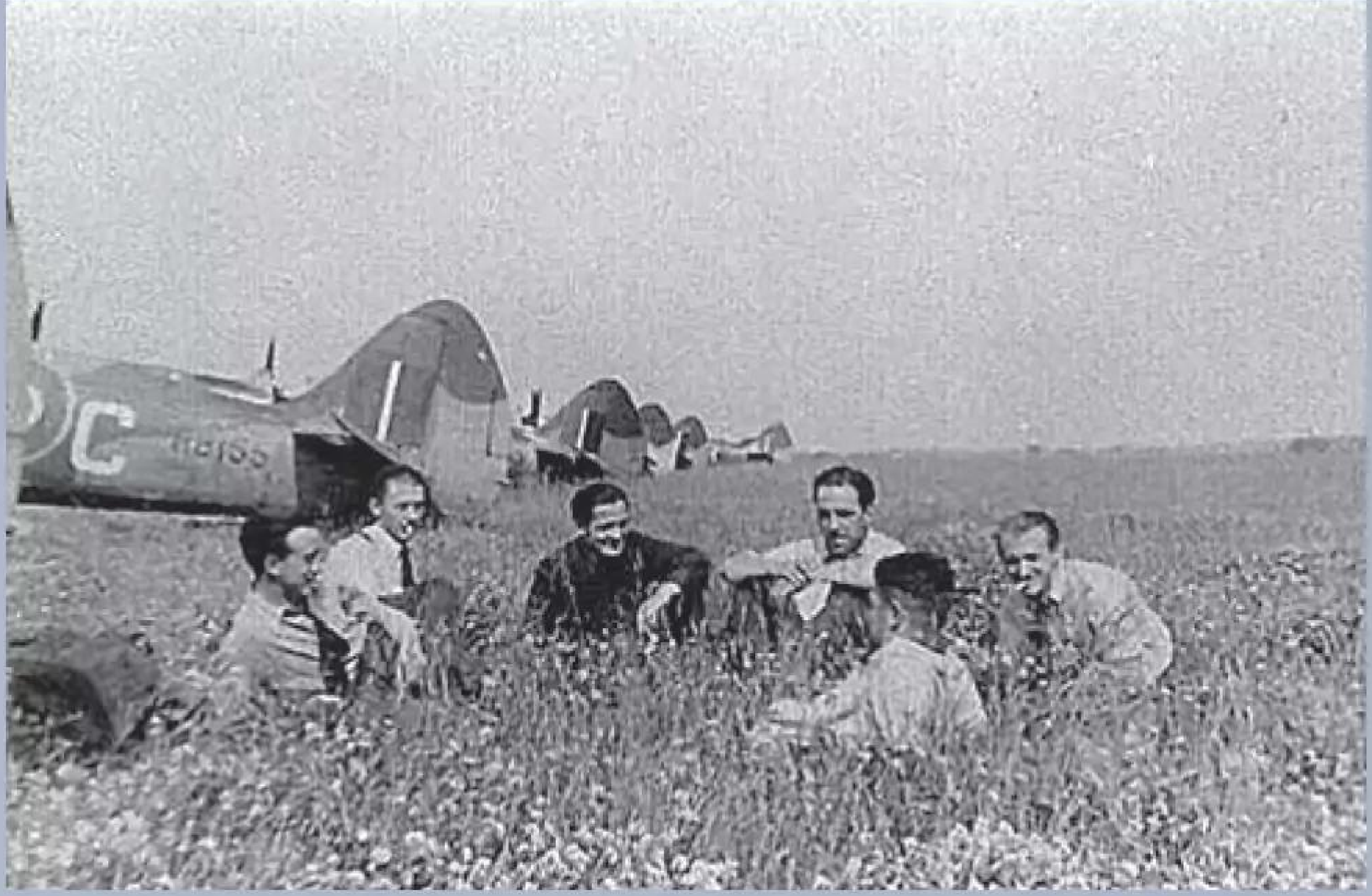
"As soon as the enemy aircraft which I identified as a Fw 190 saw me, it made a sharp turn to starboard and jettisoned its auxiliary tank. I turned to port and opening full throttle followed it as it started climbing very steeply. It then went on its back making a half roll during which time I had closed to within 200 yards. I fired twice a two second burst and the enemy aircraft blew up."

As for the diving Yellow 2, Kicq reported: "Red 1 reported enemy aircraft at 3 o'clock. I turned to starboard and caught sight of two Fw 190s some 3000ft below me proceeding on a south westerly course. I continued to turn and dived down on them.

"As soon as the enemy aircraft observed that I was chasing them, they dropped their auxiliary tanks and dived onto the deck. They were in line abreast at 30 yard intervals some 300 yards from me. Every time I closed in, the one on the port side turned to port, followed three or four seconds afterwards by the other one.

"While turning after them I fired many short bursts and observed strikes on the fuselage of the starboard enemy aircraft. I then climbed and waited until they were again in formation below me and I resumed the chase once more. That happened four

Warrant Officer Jacques ‘Pichon’ Groensteen at the controls of his battered Spitfire. *via Serge Bonge*



Pilots of 350 Squadron at ease in the grass behind a lineup of their Spitfires. The aircraft nearest the camera, RB155 was being flown by Des Watkins when he shot down a Focke-Wulf Fw 190 over Berlin. *via Serge Bonge*

The leader of 350 Squadron’s Yellow Section on April 20, 1945, was Pilot Officer Desmond ‘Des’ Watkins, from Llwyn-y-pia in the Rhondda Valley, south Wales. He was an experienced pilot despite being only 23 years old. Greg Lance-Watkins

Pilot Officer Marcel Doncq, left, with Robert Muls, right, and another pilot. Doncq, a former soldier with the Belgian Army, had escaped the Germans and fled to Spain, only to be captured by fascists. He was eventually liberated and made his way to Britain and joined the RAF to carry on the fight. *via Serge Bonge*

times. On the fourth occasion they split up and I dived from 4000ft on one of them and fired line astern from 250 yards for a second. The enemy aircraft again turned to port but crashed into a tree.”

Howorth, Red 3, wrote: “I was about to follow Yellow section when I saw a Fw 190 coming down on me from above. I pulled to one side skidding and he overshot me. I turned in and gave him a two second burst at about 100 yards closing and climbing slightly and turning starboard. I saw strikes on the engine and cockpit. I broke away to avoid the debris.

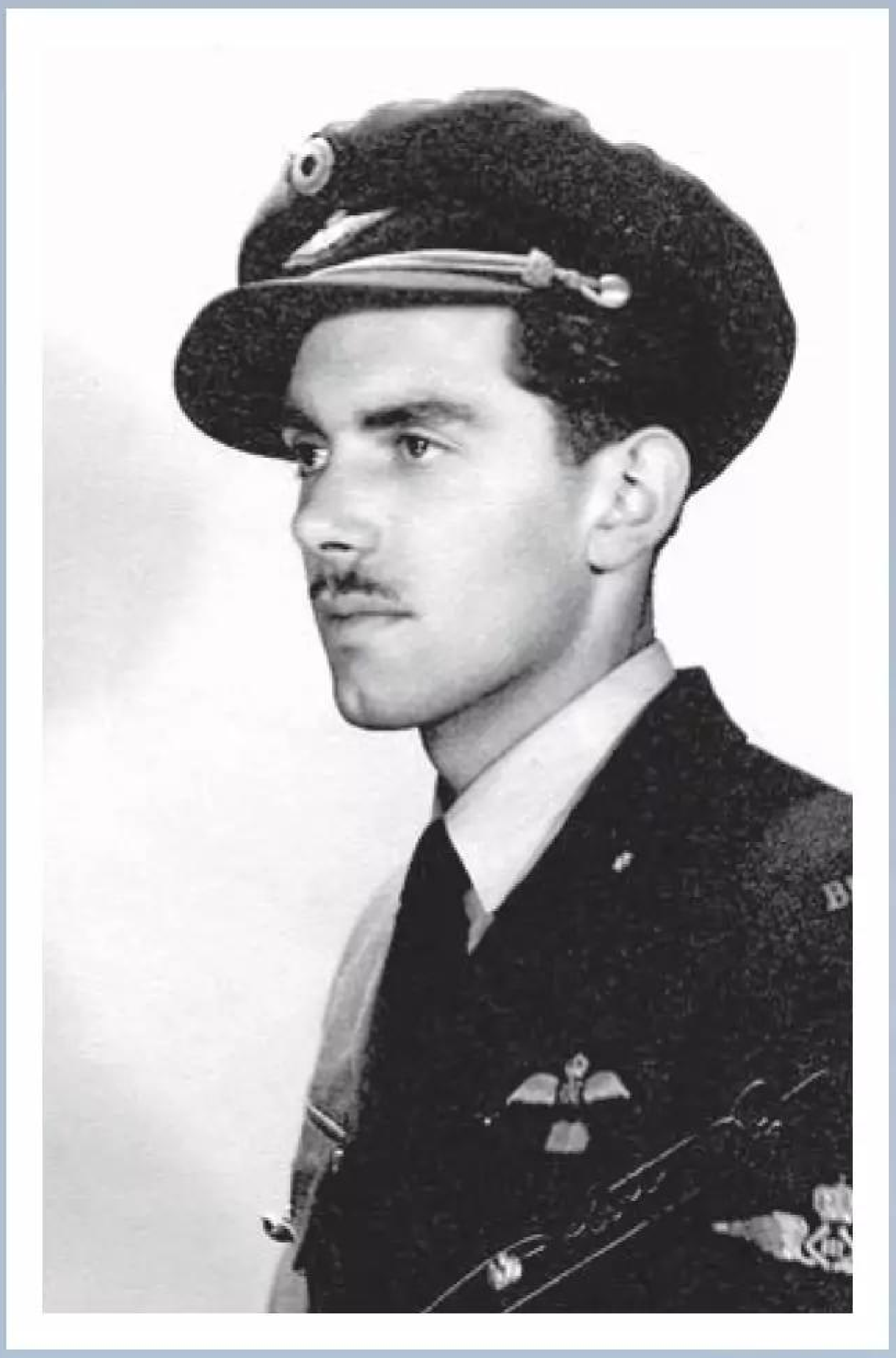
“The pilot of the Fw 190 left the cockpit but no parachute was seen to open. I was at about 8000ft. There being no more enemy aircraft I climbed above cloud (about 12,000ft) and rejoined the rest of the squadron.”

The leader, Muls, reported: “Red 3 reported two enemy aircraft below flying south-west, and at the same time I saw a gaggle of eight enemy aircraft about a mile to starboard flying slightly below. Yellow section went down to attack when I saw a Fw 190 climbing towards me.

“While the enemy aircraft was turning towards me I opened fire at about 500 yards continuing to fire head on. The enemy aircraft was also firing but I was not touched. We closed to 50 yards or less when the enemy aircraft dived down. At that moment I observed an explosion followed by a trail of smoke on the enemy aircraft’s starboard wing root.

“I dived to port and saw the enemy aircraft diving steeply down but did not follow on account of other enemy aircraft being around.” ➤

Despite being the youngest of the seven Spitfire pilots from 350 Squadron flying over the edge of Berlin on April 20, 1945, Flight Sergeant Andre Kicq, 21, was the only one to have previously downed a Focke-Wulf Fw 190 single handed. *via Serge Bonge*



Jacques Groensteen was just 22 years old when his Spitfire, flying flat out at extremely low altitude as he chased a fleeing Fw 190, hit an obstacle on the ground and crashed. His remains lay undiscovered at the wooded crash site until investigators found them in 1999 and he was laid to rest in 2003 with full military honours. *via Serge Bonge*

Suddenly, it was all over. During the skirmishes, Pauwels had stuck with Howorth and confirmed his victory, but of 'Pichon' Groensteen there was no sign. He had last been seen diving in to attack the Fw 190s but nothing had been heard from him since. After the six remaining pilots touched down back at Celle, Red section at 8.20pm and Yellow at 8.37pm, Groensteen was posted as missing.

Crash site

It would be 55 years before Groensteen was seen again. In 1999, a team of German aviation historians searching for the crash site of a B-24 bomber that went down near Berlin during the summer of 1944 were told about a promising woodland debris field comprising hundreds of metal parts.

The team investigated and immediately found aluminium wreckage that indicated the site of a plane crash. There were so many pieces that the Germans at first thought that they had found the bomber. However, they soon found parts painted in colours only used in the manufacturing of British aircraft.

Part of a canopy frame was then discovered with bits of Plexiglas still stuck in it and it became evident that this was the last resting place of a Spitfire. Further finds included a rear view mirror and pieces of the engine stamped with the Rolls-Royce logo. Guns and ammunition were found too – indicating that this was not a reconnaissance version of the Spitfire and that it therefore could not have crashed near Berlin before 1945.

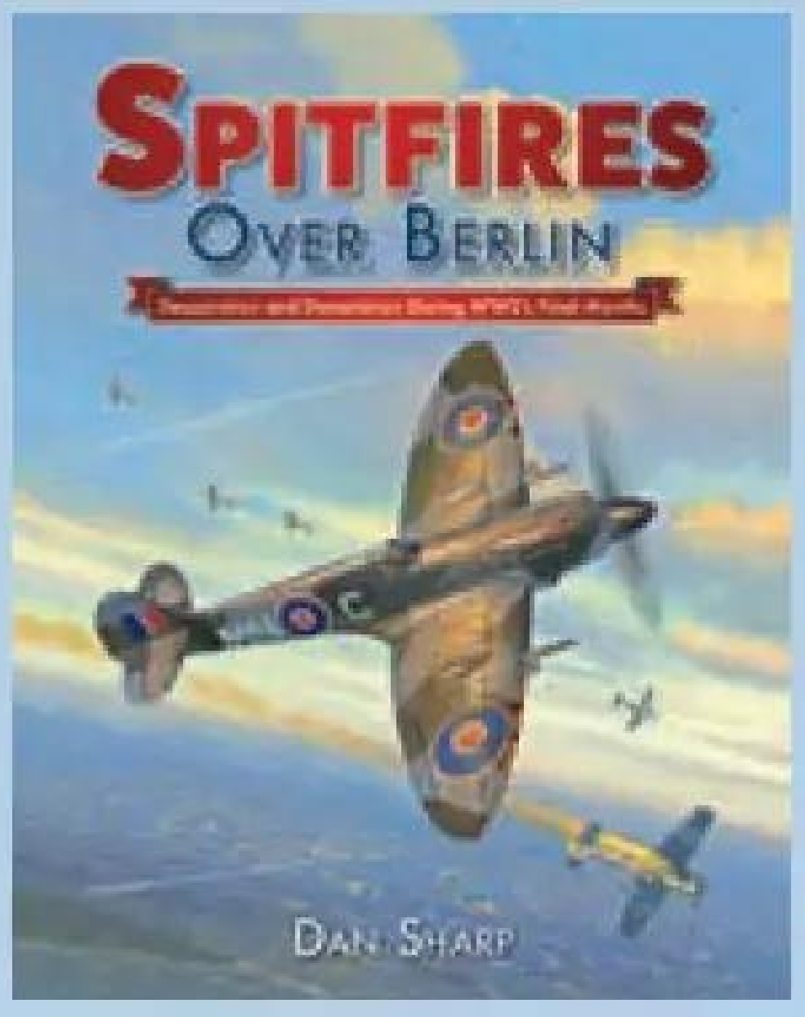
An initial theory was that this was a Russian-operated Lend-Lease Spitfire but this was discounted when a brass plate was found indicating that this was a Griffon 61 engine – the Russians never received Griffons. It was now clear to the team whose Spitfire they had found.

Researching the time and date of Jacques Groensteen's crash, they uncovered an account from the official records of IV./JG 51 Mölders. Oberfeldwebel Heinz Marquardt of 15./JG 51, an ace with more than 100 victories, had been flying a Fw 190 D-9 south of Berlin on the evening of April 20, 1945, escorting some Fw 190 fighter-bombers on their way to attack Soviet ground units to the west of the city.

On his way back, Marquardt was radioed by a comrade to say that he was being attacked by four Spitfires. Marquardt flew to the rescue but had been flying too high. As he dived down, he saw a flash on the ground and assumed that his comrade had already been killed, but to his surprise he received a second communication from his comrade to say that one of the Spitfires had "touched the wires and crashed". The battle on April 20 had taken place near two radio transmitting stations.

Bones were also found at the crash site, along with goggles and the dial of a wristwatch – the hands of which had marked it at 7.35 through the force of the impact. The investigators determined that the crash had happened at high speed, with the Spitfire flying east, and the debris field covered an area measuring 160 by 60m. Much of the debris was just bent up pieces of metal but around 200 pieces could be positively identified and based on this evidence it was conclusively proven that the wreck was that of Jacques Groensteen's Spitfire Mk.XIVc.

In 2003, after 58 years, what remained of Jacques Groensteen was put into a small coffin, draped with the Belgian flag, and flown back to Belgium. The coffin was met by the Belgian Defence Minister Andre Flahaut and then transferred, with full military honours, to the cemetery at Evere, Brussels. A funeral was held on April 8, 2003, and Groensteen was finally laid to rest among other fallen Belgian pilots of the Second World War. ■



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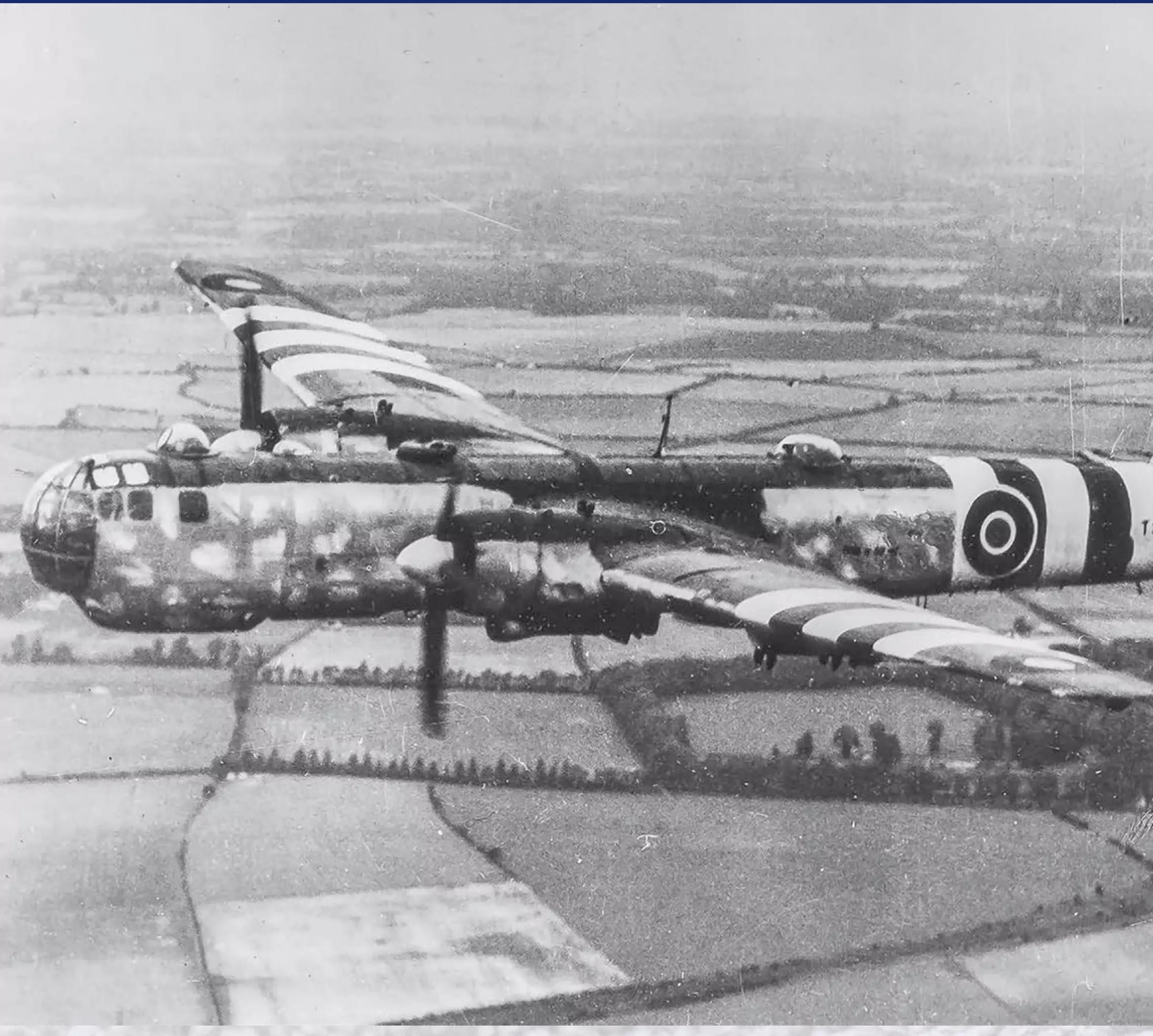


This Heinkel He 177 bomber, captured by the French Resistance in August 1944, was flown by Brown at Farnborough a month later.

Eric 'Winkle' Brown

1919-2016

Looking back on the remarkable career of world record-breaking naval officer and test pilot **Eric 'Winkle' Brown**.

Captain Eric Melrose 'Winkle' Brown, CBE, DSC, AFC, Hon FRAeS, RN, was a British Naval officer and test pilot who flew 487 types of aircraft.

He was born in Leith near Edinburgh, Scotland, in 1919, his father was a pilot in the Royal Flying Corps (RFC). Brown got his first taste of flying when, as a young lad, his father took him up in a Gloster Gauntlet.

During his years in service, Brown flew a variety of aircraft which included bombers, fighters, airliners, helicopters, flying boats, gliders and amphibians. He was also involved in aviation research, the assessment of German jets and rocket aircraft, rotary wing flight, and the first carrier deck-landing of a jet aircraft.

Brown's father took Eric to the 1936 Olympics in Berlin, where they met Hermann Göring and Ernst Udet, both fighter aces of the First World War. On discovering Brown's love of flying, Udet took the young lad up in a two-seater Bucker Jungmann from Halle airfield and, after some daring aerial acrobatics, Udet said that Brown had the temperament of a fighter pilot and should learn to fly.

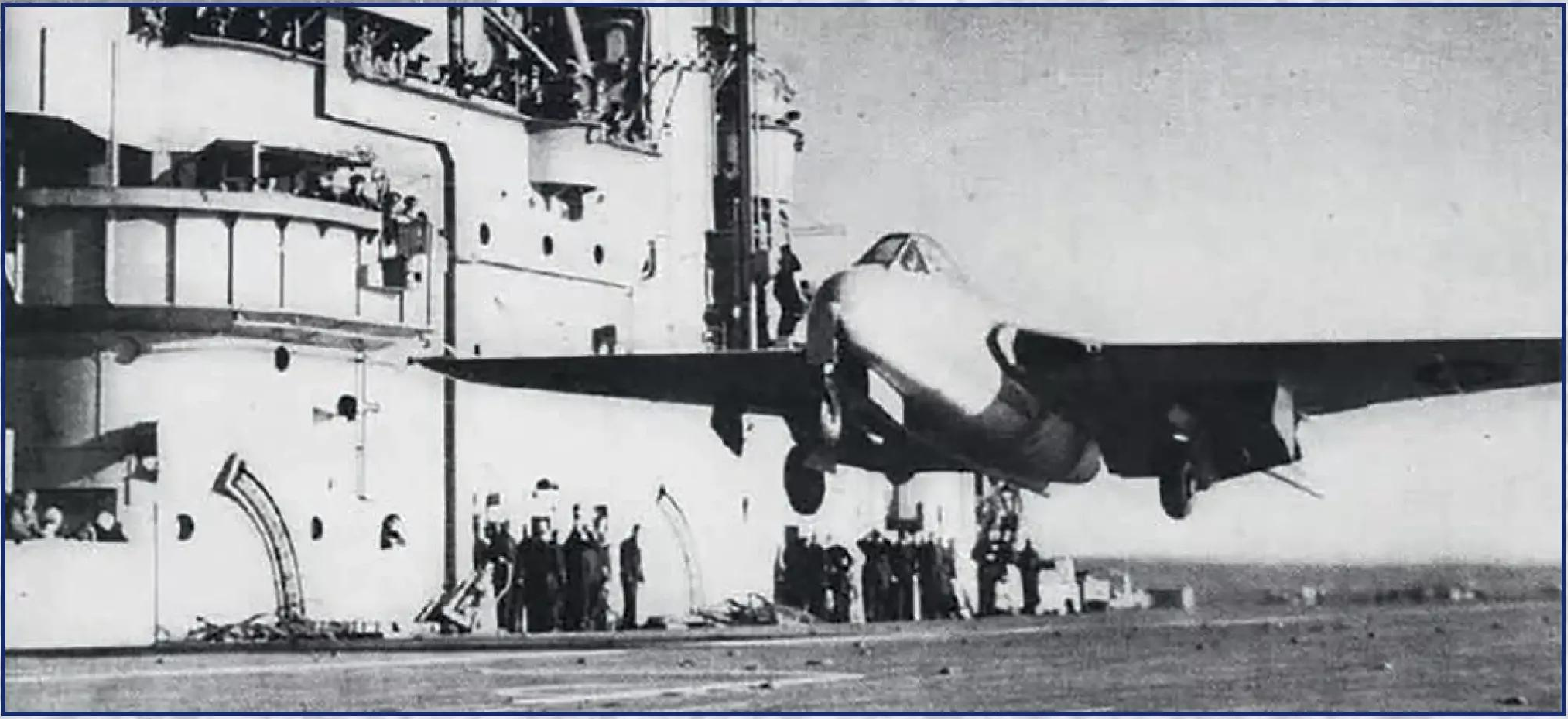
In 1938, Brown returned to Germany, where he saw a Focke-Wulf 61 helicopter demonstration flown by the aviatrix Hanna Reitsch, who Brown got to know during his visit.

Eric 'Winkle' Brown.

The following year, while taking part as an exchange student at Schule Schloss Salem in Germany, Brown was woken one morning to be told: "Our countries are at war", he was arrested by the SS and escorted to the Swiss border. He was allowed to keep his MG Magnette, as an SS officer had said to him: "We have no spares for it."

Brown learnt to fly in the University Air Squadron and back in Britain, he volunteered for the Fleet Air Arm. His first position was in the 802 Naval Air Squadron, flying the Grumman Martlet from the escort carrier HMS *Audacity*, where he helped provide fighter protection to North Atlantic convoys. Brown was twice involved when his squadron shot several German long-range bombers, and he was awarded the DSC for his bravery and skill in action.

HMS *Audacity* was torpedoed and sunk in December 1941, and Brown was one of the survivors.



Brown makes the first carrier deck landing in a jet fighter - a de Havilland Sea Vampire - on December 3, 1945.

Brown tested the newly navalised Hawker Sea Hurricane.

Fairey Firefly F. Mk 1. Brown crashed a Fairey Firefly on the deck of HMS *Pretoria Castle*, fortunately he was unhurt.

A Mosquito operating off HMS *Implacable* circa October 1944.

Though Brown never actually qualified as a test pilot, his flying ability was so outstanding that he was sent to the Royal Aircraft Establishment (RAE), Farnborough, to test the newly navalised versions of the Spitfire and Hurricane. He also tested various aircraft carriers' landing arrangements, suffering a mishap in September 1943, when he crashed a Fairey Firefly on the deck of HMS *Pretoria Castle*. He hit the crash barrier, sheared off the undercarriage and shredded the propeller, but fortunately, he was unhurt.

By the end of 1943, he had already clocked up some 1,500 deck landings on 22 ships. In March 1944, serving as chief naval test pilot, Brown landed the heaviest aircraft to land on a carrier, a specially modified Mosquito FB Mk.VI, which he landed on HMS *Indefatigable*.

In 1944, Brown flew several stints with Fighter Command during the air defence of Great Britain. Around this time, Brown's home was destroyed by a V-1 'Doodlebug' missile, his wife was concussed and his cleaner was seriously injured.

While working with the RAE, Brown helped the United States Air Forces (USAAF) to come to a decision as to which aircraft was the most manoeuvrable at speed, the Lightning, Thunderbolt or Mustang. After comprehensive tests, Brown and the other test pilots agreed that the Mustang was superior to the others, so the USAAF went with it as their standard bomber escort fighter.

On 2 May 1944, Brown was appointed MBE 'for outstanding enterprise and skill in piloting aircraft during hazardous aircraft trials'.

Jet propulsion was the next progression in aircraft power and during a chance meeting with Frank Whittle (Royal Air Force officer said to have invented the turbojet engine) Brown asked Whittle if he could make the jet engine suitable for naval use.

This resulted in the Gloster Meteor being chosen as the RN's first jet fighter, though the Navy used very few of them as fighters.

Helicopters were Brown's next challenge, when asked with fellow test pilot, Squadron leader Anthony F. Martindale to pick up two Sikorsky R-4Bs for the Aerodynamics Flight from RAF Speke. On arrival, the American mechanics were assembling the machines and when asked for a lesson on how to fly them, Brown and Martindale were handed a booklet. 'This is your instructor', said the master sergeant. A quick study and some attempts at hovering and controlling and the two set off for Farnborough. They made it safely, if somewhat raggedly at times.

Another first for Brown was when he took off and landed the first aircraft with a tricycle undercarriage on a carrier. It was on HMS *Pretoria Castle* and Brown was flying a Bell Airacobra which had been modified with a tail hook.

He also performed the first landing of a jet aircraft on a carrier, a de Havilland Sea Vampire on the carrier *Ocean* on December 3 1945. When Brown reported that only very skilful pilots like himself would be able to repeat the operation safely, the Admiralty immediately ordered repeat trails by others, which were carried out safely.

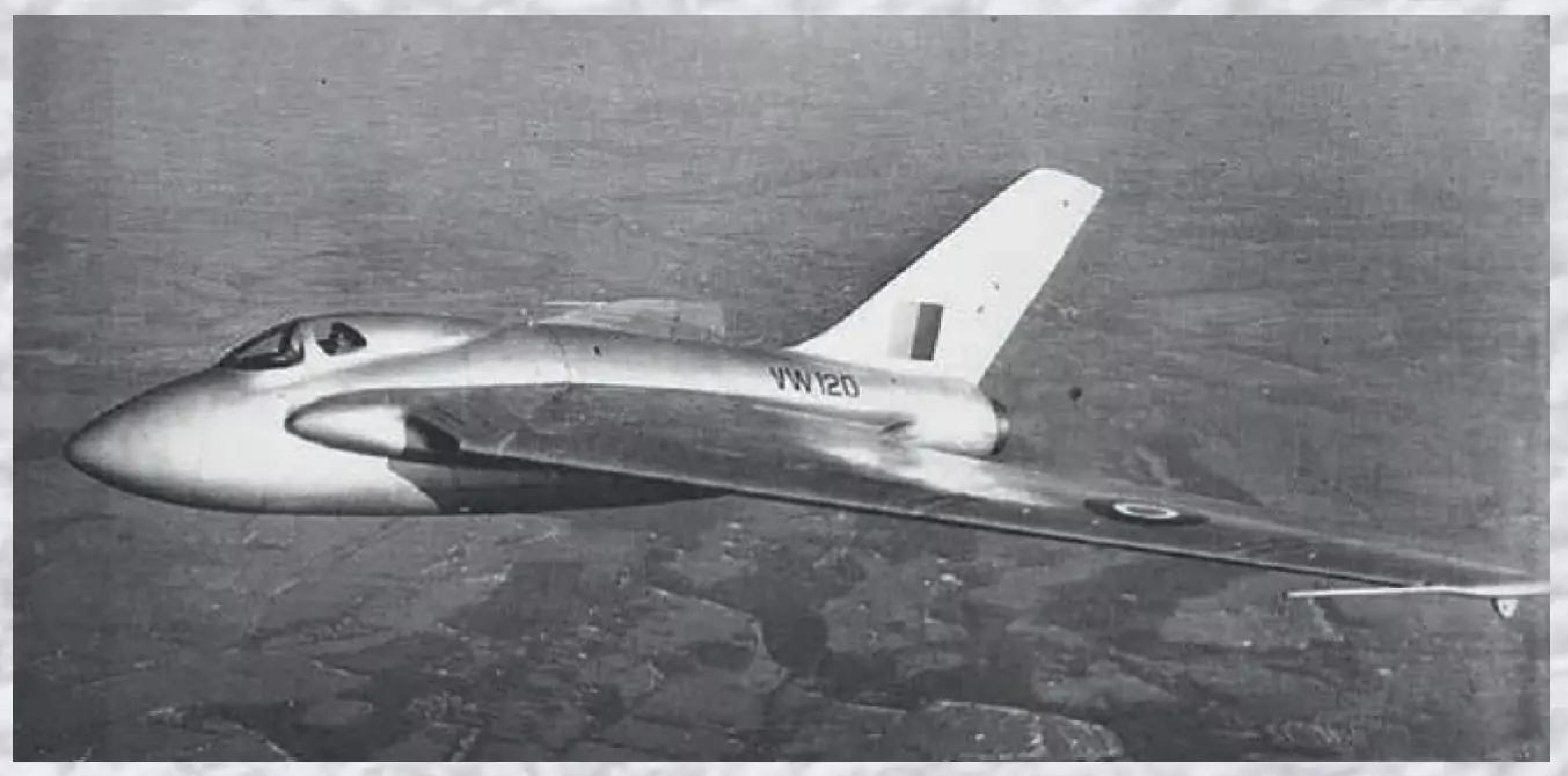
As the war in Europe came to an end, Brown, being able to speak German, was asked by the RAE to head a team to bring back some captured German aircraft from a base in Denmark which the RAE could study and gain extra aeronautical knowledge.

On arrival, Brown was surprised to find the airbase was still an operational Luftwaffe base, but fortunately the commanding officer offered his surrender and Brown took control of the airfield and its 2,000 men until Allied forces arrived the next day. Brown and his team managed to ferry twelve Arado Ar 234s across to Farnborough.

Brown also got involved with the interrogation of German prisoners, when asked by the Medical Officer of the British 2nd Army who were occupying the liberated Bergen-Belsen concentration camp to assist.

He interviewed Josef Kramer and Irma Grese, and recalled the experience saying that; "Two more loathsome creatures it is hard to imagine" and described the latter as "…the worst human being I have ever met." Kramer and Grese were later tried and hanged for war crimes.

After the war, Brown commanded the Enemy Aircraft Flight, an elite group of pilots testing captured German and Italian aircraft, which included the Messerschmitt Me 163 Komet. Brown also renewed acquaintances with the German pilot Hanna Reitsch whose father during the war, fearing the approaching Russians, killed Hanna's mother, sister and then himself.


Brown described the third de Havilland DH.108 Swallow prototype, VW120, as "a killer" after flying it in 1949. It was destroyed in a crash on February 15, 1950, which also took the life of its pilot, Squadron Leader Stuart Muller-Rowland.

In 1946, Brown tested a modified version of the de Havilland DH.108 Swallow in which Geoffrey de Havilland Jr. was killed while diving at speed.

Like de Havilland, Brown also experienced the aircraft going wildly out of control while diving at speed, but, remembering the drill of pulling back gently on both the stick and throttle, the aircraft steadied. Brown believed he survived partly because of his small stature, as de Havilland suffered a broken neck, possibly due to the violent oscillation. Brown had said it was a dangerous aircraft and subsequently, all three DH. 108s were lost in fatal accidents.

While testing a Saunders-Roe SR.A/1 flying boat, Brown hit some submerged debris. He was knocked unconscious by the impact and was dragged from the cockpit by Saunders-Roe test pilot Geoffrey Tyson.

In 1951, Brown was promoted to lieutenant-commander, then commander in 1953 and captain in 1960.

Brown demonstrated the steam catapult to the Americans in 1952, by flying a Grumman Panther off HMS *Perseus*, the Americans then featured it on future carriers.

Around this time, Britain had invented the angled flight deck, which Brown was asked to promote. Having seen it, the US Navy modified USS *Antietam* to accommodate the new concept, and it was ready nine months later.

Brown returned to Germany in 1957 becoming Chief of British Naval Mission to Germany, helping to re-establish German naval aviation. A brief spell as test pilot for the revived Focke-Wulf company followed.

In the 1960s, Brown was consulted on the flight deck arrangement of the planned new UK-class of carrier the CVA-01, which was later cancelled. Brown's last appointment in the Royal Navy was in 1967 when he took command of HMS *Fulmar*. He was appointed a naval aide de camp to Queen Elizabeth II in 1969 and received a CBE in 1970 and then retired from the Royal Navy the same year.

Brown became president of the Royal Aeronautical Society from 1982-83 and had his last flight as a pilot in 1994. He was still speaking in public up to 2015.

Brown lived in Copthorn, West Sussex with his wife Evelyn who died in 1998. In 2014, Brown was the subject of an hour-long documentary on BBC Two, *Britain's Greatest Pilot*: *The Extraordinary Story of Captain Winkle Brown*.

As a guest on BBC Radio 4's Desert Island Discs, in 2014, the 95-year-old Brown said he still enjoyed driving and had just bought himself a new sports car. His favourite piece of music was, 'Stardust' by Artie Shaw and His Orchestra.

Speaking at the University of Edinburgh Mountbatten Lecture in 2015, Brown said the Russians were playing a dangerous game chess which showed the same signs as what caused the Cold War.

In May 2015, Brown was awarded the Founder's Medal by the Air League – a charitable aviation organisation based in the UK, which was founded in 1919.

Eric Winkle Brown died on 21 February 2016 following a short illness.

His nickname 'Winkle', was given to him by his Royal Navy colleagues. It is short for 'Periwinkle' a small mollusc. This was because of his short 5ft 7in stature. ■

Birth of the F-15 Eagle

Developed at the Pentagon after observing modern Soviet designs and refined through the Vietnam War, the F-15 Eagle became a premier air-to-air fighter, but the journey to its first flight was lengthy, as Bertie Simmonds discovers...

Old and new: A McDonnell Douglas F-4E leads an early F-15A. The F-4 was originally designed as a fleet interceptor, before becoming a fighter-bomber, recce aircraft and 'Wild Weasel' SAM killer... It would be some years before the Eagle's latent air-to-ground potential would be realised as the F-15E Strike Eagle.

Many different outside forces were acting on the United States of America's military procurement machine in the decade before the F-15 Eagle's entry into service.

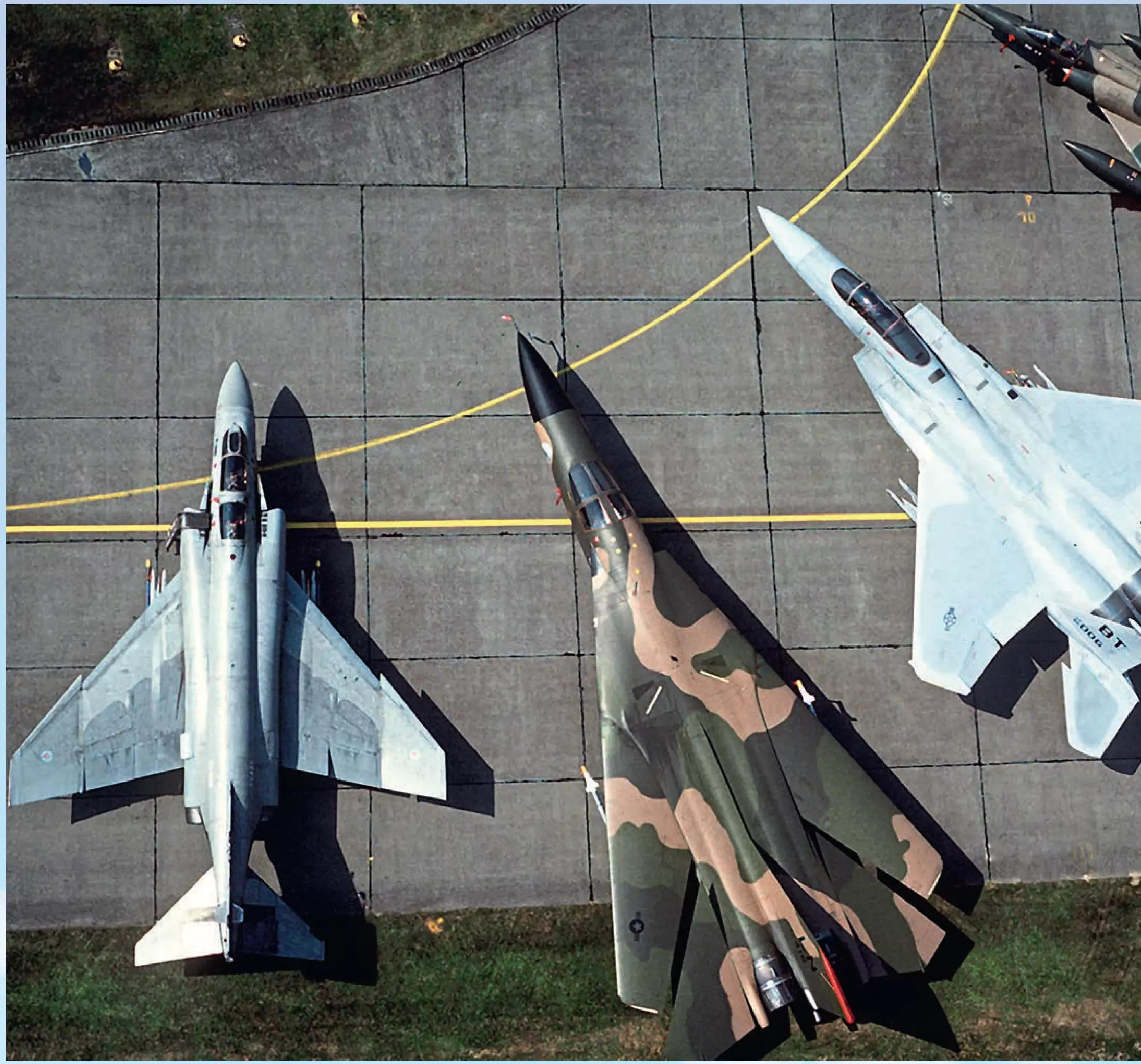
Firstly, the cost of development and procurement of high-profile weapons systems had been under close scrutiny since the early days of the Kennedy presidency in the early 1960s: John F Kennedy took office in January 1961, bringing with him Robert Strange McNamara.

McNamara's background was business school before he became a captain in the United States Army Air Force in 1943. His work during the conflict was in the Office of Statistical Control, basically increasing the effectiveness and efficiency of the late war bombers (getting them to sometimes double as transport aircraft as a consequence) in the Far Eastern theatre of war.

Connections made during wartime helped McNamara get a job with the Ford Motor Company in 1946. This job led to McNamara and nine others initially being called the 'Quiz Kids' for all the questions they asked of the old hands on the shop floor and above as well as their comparative youth to that of the Ford board. Soon this was changed to the 'Whiz Kids' and they – led by McNamara – basically restructured Ford and also looked at what products it made. At the end of 1960, Robert S McNamara became the first president of the Ford Motor Company who wasn't a member of the Ford family.

But bigger things lay ahead. Within a month of taking up the job at Ford, JFK had offered McNamara a range of jobs in his administration – he chose defence – and his job was to ensure that the Kennedy administration got the best value possible for the defence dollar.

One way of doing that was to have some sort of commonality between the services and so in September 1961, it was decided that an aircraft would be developed to fulfil both the Air Force's tactical fighter role and the Navy's fleet defence role. What came from this idea was the Tactical Fighter Experimental programme (TFX) but – despite the logical idea of a common airframe to keep costs down – the conflicting needs of both the tactical role and that of a fleet interceptor seemed insurmountable: at least in the heads of USAF Generals and USN Admirals. And this was before designs were submitted or even metal cut… ➤



This telling shot shows the various sizes of the F-4 Phantom (in British FGR.2 form) McNamara's TFX, which became the General Dynamics F-111, the F-15 Eagle and the French Dassault Mirage, seen here in Belgian colours.

The winner of the TFX competition was announced at the end of 1962 as General Dynamics, operating out of Fort Worth, Texas. The aircraft designed and built for these roles was to become the F-111. In USAF guise it would be a variable-geometry (or 'swing wing') nuclear and conventional interdictor while (with Grumman's help) the F-111B would be a long-legged fleet interceptor, armed with a new breed of ultra-long-range air-to-air missiles.

Cutting a long and painful story short, during sea trials it was found that the F-111 was too big and too heavy to be a fighter or interceptor of any real use to the Navy. Their variant had first flown in 1965 and a series of development issues – including with the Pratt & Whitney TF-30 engines and fatal crashes – marred the programme. Also, the costs had tripled. Little wonder deck crews had nicknamed it the 'Sea Pig'. The F-111B project for the Navy was finally killed in 1968 when – during a congressional hearing concerning the project Admiral Tom Connolly made his famous statement: *'Mr Chairman, all the thrust in Chistendom wouldn't make a fighter out of that aircraft.'*

Around $400 million had been spent on the F-111B alone, but thankfully, the engines and weapon systems were used as the basis for the US Navy's F-14 Tomcat while the USAF's F-111 variants (FB-111A, F-111A, D, E, F and EF-111 Raven 'Spark Varks') served the US well into the 1990s with the Royal Australian Air Force buying the F-111C version which served until 2010.

This turn of events with the Navy's F-111 and the maturing USAF version initially

didn't look good for the government of the day or General Dynamics. While the strike-fighter version would mature into a fine aircraft, the first combat deployment in 1968 was perhaps too much too soon for this innovative aircraft. Three from the original six deployed were lost within the first month, due to issues with their horizontal stabilisers, rather than enemy action. It would be another three years before the F-111 was declared fully operational and – as fine an aircraft as it became – it was also hampered by its original 'Jack-of-all-trades' design and, while it was capable as a nuclear armed strike-fighter, initially a 'conventionally armed' F-111 with a full load of Mk.82 iron bombs wasn't capable of flying higher than around 16,000ft. This – alongside improvements in Soviet surface-to-air (SAM) missile systems – led to the F-111 becoming a low-level strike aircraft.

By now, McNamara was gone to a new job at the World Bank. His legacies included that of being (still) the longest-serving Secretary of Defence, serving from 1961 until 1968 under both Kennedy and his successor Lyndon Johnson. Another legacy that lived on after he'd gone was the culture he fostered of attempting to keep costs down: sometimes this bore fruit, such as almost forcing the USAF to employ the Navy's F-4 Phantom II and during the UN Navy's search for a replacement for the venerable Douglas A-4 Skyhawk light-attack aircraft.

A request for Skyhawk replacement proposals required that they be based on an existing airframe. Strangely (and cheekily) the Vought team put forward the A-7 Corsair II, which any plane-spotter could see only shared the basic shape of the F-8 Crusader and very few common parts! Following the Navy's successful debut of the A-7A into combat over Vietnam in 1967, the USAF quickly adopted its own version – the A-7D – for its own tactical role over South East Asia, more on which below…

The lessons from previous wars and Vietnam

As we've already discussed, the lessons re-learned in the skies over Vietnam were hard-earned.

Just before the conflict, the USAF was expecting to have a general 'mix' of the F-111 and the F-4 Phantom II for the 1960s and beyond. In 1963, 'Project Forecast' was a paper which set out to identify future requirements for the USAF. In it, General Bernard A Schriever of Air Force Systems Command said that fighter needs in the 1970s would be best met by the F-111 and F-4 variants: *"Optimised for the air-superiority role… and that strategic bombing from aircraft able to fly higher and faster than the enemy would ensure air superiority."* Project Forecast added: *"…the counter-air force must be able to destroy aircraft in the air."* So, any in-bound attackers had to either defend themselves or have the appropriate cover.

Around a year later in 1964, Major General Arthur C Agan was becoming frustrated that many in The Pentagon believed dogfighting and the use of guns on aircraft was an anachronism: as a former P-38 Lightning pilot in the Second World War, Agan didn't think this was the case and argued the case in favour of keeping guns as a fighter weapon. In the autumn of 1964, he presided over a committee of former fighter pilots to look at the USAF's then-current tactical capabilities.

It was hoped that at the very least they could use the findings to push the case for an internal gun in any future version of the USAF's F-4C. The committee was eventually chaired by Brigadier General Harrison Thyng (Second World War and Korean War ace), Colonel Francis 'Gabby' Gabreski (also an ace in both those conflicts), Brigadier General William Douglas Dunham (a ➤

By the late 1960s, the revelation of new Soviet high-speed interceptors such as the Su-15, MiG-23 and (seen here) MiG-25 gave the F-X programme greater impetus.

triple ace in the Second World War) and other former air-to-air veterans.

Understandably, this group of famous old fighter jocks came to the conclusion that a new fighter should be developed to counter the Soviet's increasing capability in this area. By this time it was known that more modern versions of the MiG-21 were in development, much more advanced than the early models which were based on the basic airframe which first flew in 1956.

Initially, the group's findings fell on deaf ears, but in early 1965 the incoming Chief of Staff – General John P McConnell – urged Agan to draft a statement on tactical air superiority. This was finally circulated all across the USAF's chain of command in May 1965 – just as combat operations over Vietnam had begun…

While this was happening, Lieutenant Colonel John W Bohn Jr. had been tasked – since the previous August – to produce a study entitled: 'Force Options for Tactical Air'. This report critically assessed the USAF's reliance on high-performance tactical fighters to provide: *"…the greatest flexibility at the lowest cost."* Things were starting to come to a head, as – around the same time – it was becoming obvious that the TFX/F-111 was purely a strike aircraft and when this became clear, some of the top brass – convinced by Bohn's findings when the study was completed at the end of February 1965 – wanted to move to a 'high-low' mix of low-cost fighter-bombers with expensive, more capable ones.

The low-cost elements were a way of strengthening the USAF by sheer weight of numbers. The aircraft looked at, included many different versions of various existing aircraft, including the F-4, the Douglas A-1 Skyraider, Grumman A-6 Intruder and F-104 Starfighter – although by now it was accepted that the Starfighter was nothing other than an export success rather than a tactical USAF one.

Eventually this 'low' mix came down to two designs. The first was initially going to be a higher-specification version of Northrop's F-5, which was proving popular in the export market, while the other was to be a land-based version of the Vought A-7 Corsair II, which – while not as effective as the agile F-5 in the fighter role – could carry a much higher payload and was already proving its worth in the US Navy as an accurate strike aircraft.

Arguments went to and fro as to what aircraft would best fit the bill – and other arguments came about as to what future 'premier' fighter could guarantee the survival of any new aircraft. As was often the case, yet another Air Staff study was made – under the direction of Colonel Bruce Hinton (a former Korean War ace) looking at a future 'Tactical Fighter Ground Attack Aircraft'. This ended in 1965 with the A-7 Corsair II as overall winner. History would show that the F-5 would be employed in the aggressor/adversary role for the USAF, while the A-7 would go on to have a long and fruitful USAF career, coming into use in 1970 and departing the last Air National Guard units to operate it in 1993.

These studies and counter-studies, arguments and counter arguments showed the way the system was in the United States and in The Pentagon during the 1960s: confusing, to say the least. What ultimately was decided from these studies was that the more capable, more expensive fighter was to be labelled F-X and this was to become the F-15, although even then the specification of the aircraft was to change this way and that as the arguments ebbed and flowed.

Initially it was going to be a multirole aircraft, then a pure fighter; also the size/weight of the aircraft would change. Meanwhile, the air war over Vietnam was showing a real need for a pure air superiority aircraft. On April 4, 1965, two bomb-laden Republic F-105 Thunderchiefs were shot down by supposedly 'obsolete' Korean War vintage MiG-15s.

So – as the decade wore on – both the USAF and US Navy would find themselves equipped largely with a fast, powerful but none-too agile interceptor, equipped solely with air-to-air missiles (F-4 C/D and B/J Phantom IIs) which were expected not only to be employed in the strike/attack role, but also actually dogfight with smaller, more nimble gun-toting MiG-17s, 19s and 21s. Meanwhile, the fighter-bombers were even harder pressed – especially in the face of localised fighter opposition when they flew without escort.

Soviet supremacy?

The 'West' had felt that its military aircraft had the edge on anything designed by the Soviet Union, probably since the Spanish Civil War of the 1930s. There, in clashes in the skies above, rotund Polikarpov I-16 'Ratas' of the Republicans would take on the sleek Messerschmitt Bf 109s of the Nationalists.

However, this well-known image is not a particularly good reflection of the reality. The Polikarpov I-16 itself featured some modern touches for an aircraft that first flew in 1933 (monoplane, retractable undercarriage) and this pointed the way to more advanced designs from the Soviets as years went by.

By the time the Nazis had been held on the ground following Operation Barbarossa, Soviet designs were moving forward apace and mid to late war designs such as the later Yaks and LaGGs were at least the equal of anything from the West – at lower altitudes.

In the Korean War, the Soviets shocked the world with the debut of the swept-wing MiG-15 in combat and from then on until the late 1970s the Mikoyan-Gurevich design bureau was in the ascendancy.

The MiG-21 'Fishbed' first flew in 1956, but it was advanced versions of this aircraft that were beginning to worry both the USAF and the Pentagon in the early 1960s. With current versions of the F-4 Phantom II finding it sometimes hard going against the Fishbed Cs of the North Vietnamese Air Force, the second generation of MiG-21 – the PF – which stood for Perekhvatchik Forsirovannyy (Interceptor Uprated) was already flying in Russia. This second generation of Fishbed had enhanced avionics and sensors, radar-guided air-to-air missiles and uprated Tumansky R-11 F2-300 turbojets. Worse, MiG was already developing a version of this model, the MiG-21 PFL for use solely by the Vietnamese. As well-trained and superbly flown as the existing F-4C and D models of Phantom II were over Vietnam any qualitative edge the Americans may have had in general over the Soviet-built fighters was being eroded.

In 1967, the western world was shocked by the first sight of a number of new Soviet fighter aircraft. At the Domodedovo air pageant of July 1967, both the MiG-23 and MiG-25 made their debuts alongside the Su-15 'Flagon' interceptor and Su-17 attack aircraft. The West saw that the MiG-23 followed the likes of the F-111 by employing a 'swing' wing to handle the differing needs of slow speed for landing and dogfighting and high-speed for the intercept role.

The MiG-23 was a single engine aircraft while its sibling used two, huge Tumansky R-15 turbojets, giving a maximum *theoretical* speed of Mach 3.2. The MiG-23 was named 'Flogger' under US/NATO coding while the MiG-25 was christened 'Foxbat'.

As was usual back then, the knee-jerk reaction was to overplay the projected performance of these fighters: besides, this was good for defence spending! The Foxbat was actually a Soviet response to the cancelled North American B-70 Valkyrie – a Mach 3 bomber – which was cancelled in 1961 but still flying in the mid-1960s as the XB-70 test-bed. And, although it did reach Mach 3.08, it never routinely flew above Mach 2.5.

At first, US intelligence considered that both these new MiG types were probably handy air-combat dogfighters – history has since proven otherwise – especially after the defection by MiG-25 of Viktor Belenko, to Japan in 1976 – but it did add some impetus to the F-X programme. The original specifications for this were now being drawn up and – to act as a catch-all to any future MiG/Soviet design, it was decreed that the F-X would have a “*25% superiority over the MiG-21*”.

F-X gathers pace, enter the ‘mafia’...

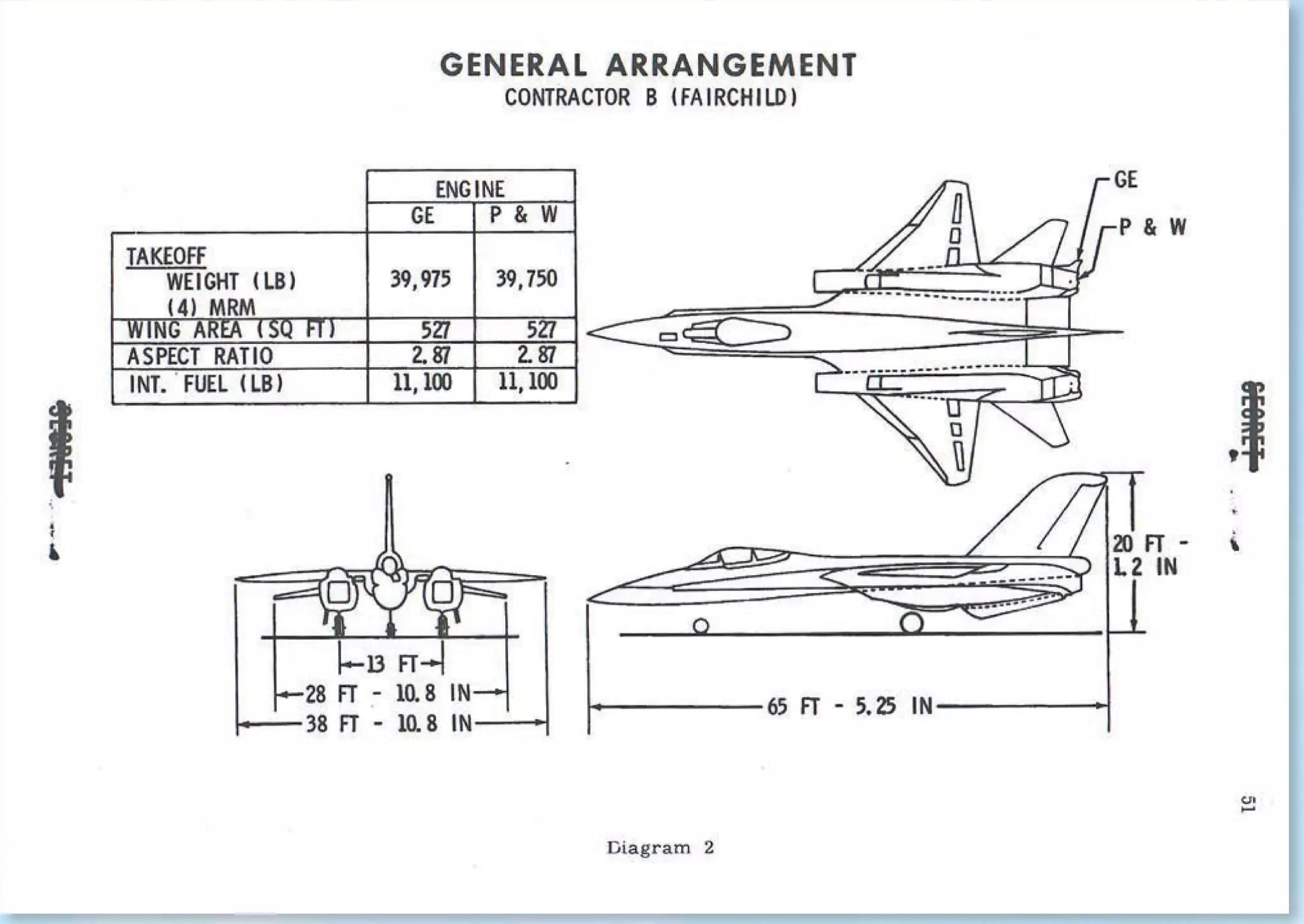
At the end of 1965, the USAF sent RFPs (Requests for Proposals) to 13 aircraft manufacturers for the initial design studies, resulting in 500 differing designs. By now the F-X was a large aircraft in the 60,000lb (27,273kg) class, a top speed in the region of Mach 2.7-2.9 with many designs using the ‘en-vogue’ variable geometry design. It was around this time that a group known as ‘The Fighter Mafia’ got involved.

Also known as ‘The Lightweight Fighter Mafia’ the core members were: Colonel Everest Riccioni, Colonel John Boyd and civilian analyst Pierre Sprey. Others are mentioned as also being ‘in the family’, including Deputy Defence Secretary David Packard and General Dynamics designer Harry Hillaker.

The F-X programme that led to the F-15 Eagle saw the original specifications increase in weight and sophistication, but many inside the Pentagon were vehemently against weight and sophistication. Sprey – a weapons systems analyst – argued for a simple machine in the 25,000lb (11,340kg) class, armed with a simple radar system, a gun and a pair of lightweight missiles, to help bolster the numbers in the USAF compared to procuring a large, complex and expensive F-X. This was initially looked on as being the F-5, then became the F-XX (or FX squared) proposal and then (ultimately) the LWF Light Weight Fighter, which finally resulted in both the General Dynamics F-16 Fighting Falcon and later the McDonnell Douglas F/A-18 Hornet.

Colonel John Boyd had a hand in both the F-16 and what would become the F-15. In October 1966, he was assigned to review the F-X studies. Boyd was a bit of a maverick. A time-served fighter pilot, he was an influential voice in the USAF’s fighter community. Further still, Boyd linked up with Thomas Christie – a mathematician – to develop his quantitative theory for measuring the energy and agility of comparative fighter aircraft. Boyd was asked to overlay this theory on the specifications of the 60,000lb aircraft that the USAF was asking for.

Eventually, both Boyd and Sprey got involved with F-X and the weight of the proposed aircraft tumbled. By September 1968, there was a more refined set of specifications from the F-X SPO (Systems Program Office). They issued RFPs to eight manufacturers and just three had ➤

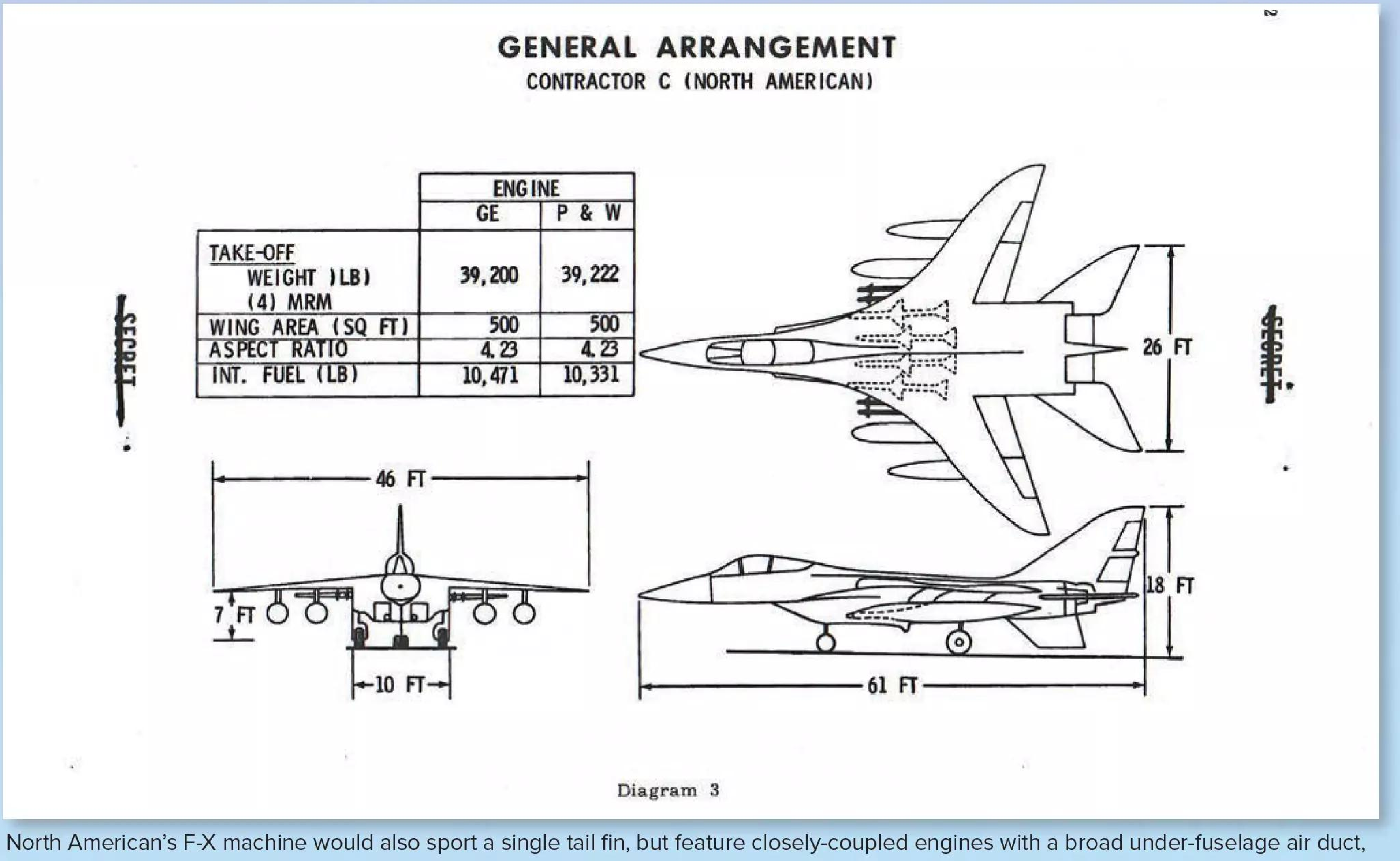


GENERAL ARRANGEMENT
CONTRACTOR B (FAIRCHILD)

	ENGINE	
	GE	P & W
TAKEOFF WEIGHT (LB) (4) MRM	39,975	39,750
WING AREA (SQ FT)	527	527
ASPECT RATIO	2.87	2.87
INT. FUEL (LB)	11,100	11,100

Diagram 2

Fairchild’s F-X offering featured a single tail fin and two widely podded engines. The area between the engines would provide additional lift, similar to the Grumman F-14 Tomcat, Sukhoi Su-77 and MiG-29 designs.



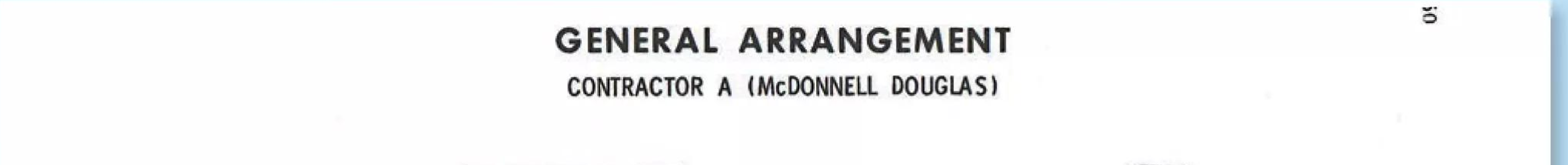
GENERAL ARRANGEMENT

CONTRACTOR C (NORTH AMERICAN)

	ENGINE	
	GE	P & W
TAKE-OFF WEIGHT)LB) (4) MRM	39,200	39,222
WING AREA (SQ FT)	500	500
ASPECT RATIO	4.23	4.23
INT. FUEL (LB)	10,471	10,331

Diagram 3

North American's F-X machine would also sport a single tail fin, but feature closely-coupled engines with a broad under-fuselage air duct, similar to the later General Dynamics F-16 and also the likes of the Eurofighter Typhoon. The four AIM-7 Sparrow missiles were grouped across the bottom of that intake trunking.



GENERAL ARRANGEMENT

CONTRACTOR A (McDONNELL DOUGLAS)

	ENGINE	
	GE	P & W
TAKE-OFF WEIGHT (LB) (4) MRM	39,523	39,740
WING AREA (SQ FT)	608	608
ASPECT RATIO	3	3
INT. FUEL (LB)	11,300	11,500

Diagram 1

McDonnell Douglas' winning offering which would later become the F-15 Eagle. This was the only F-X competitor with twin tails. This drawing interestingly shows three medium range (Sparrow) missiles in semi-conformal stowage under the intake trunks, with one area using two, short-range missiles using one such area. Clearly all three F-X aircraft used a blown 'bubble' canopy for good visibility for close-in dogfighting.

responded by the end of the year: Fairchild-Republic, McDonnell Douglas (merged together just the year before) and North American. All would receive more than $15 million each for the Contract Definition Phase.

By now the F-X was defined as a single-seat, fixed (not swing) wing aircraft, featuring twin-engines and being of around 40,000lb in weight (18,182kg). With both Boyd and Sprey angling for a more basic or austere F-X, they couldn't get the aircraft to be made any smaller but they could make it cheaper. Some of their thoughts led the F-X proposal to have reduced-cost avionics, ironically losing the TISEO system (Target Identification System, Electro-Optical) which later appeared as part of the F-15's FAST (Fuel and Sensor Tactical) packs system. The loss of this and some air-to-ground provisions lowered the unit cost of each F-X by around $1 million each. This – and other reductions instigated by Deputy Defence Secretary David Packard – meant that the entire programme stayed on or below the $1 billion limit, where the selection process could be more delicately scrutinised.

A foot-note on the 'Fighter Mafia' is that when Colonel Boyd saw one of the first mock-ups of the F-15, he looked up in astonishment and gasped: *"Good grief, it's too big!"*

McDonnell Douglas wins it

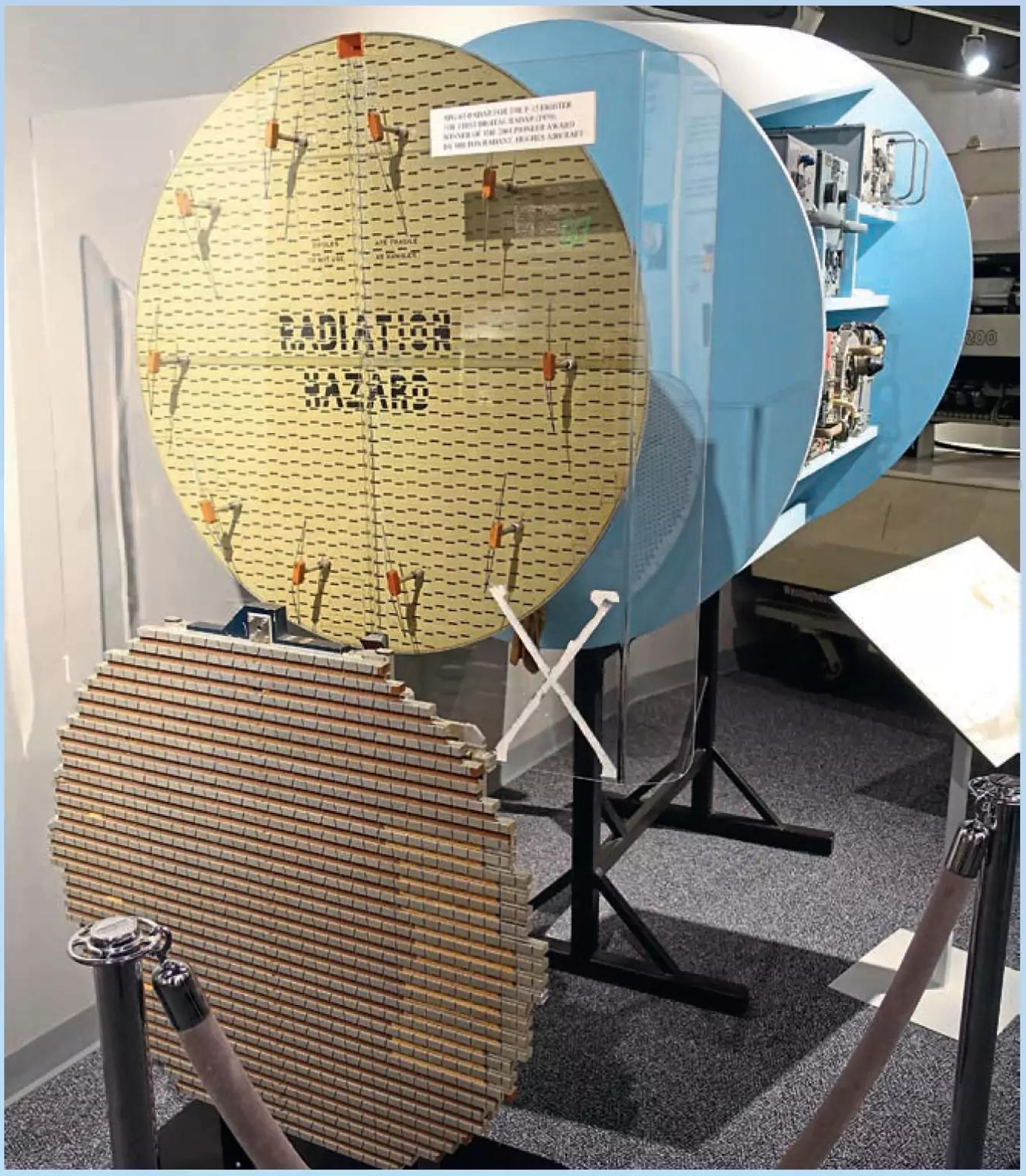
So let's look at the three main designs for the F-X/F-15 proposal as it was now named.

'Contractor C' was North American, with a 46ft wingspan and a 500sq ft wing area. Internal fuel was rated at around 10,400lb with a take-off weight with four medium-range air-to-air missiles at around 39,200lb. The general design featured centrally-buried engines, angled intakes and a single large fin (with dorsal fin) and a blown cockpit canopy.

'Contractor B' was Fairchild, with two, podded engines under each wing, a single vertical fin, bubble canopy and widely-spaced horizontal fins as a result of being attached to the engine trunks. Wing area was around 527sq ft and internal fuel 11,100lb. Take-off weight was around 39,800lb.

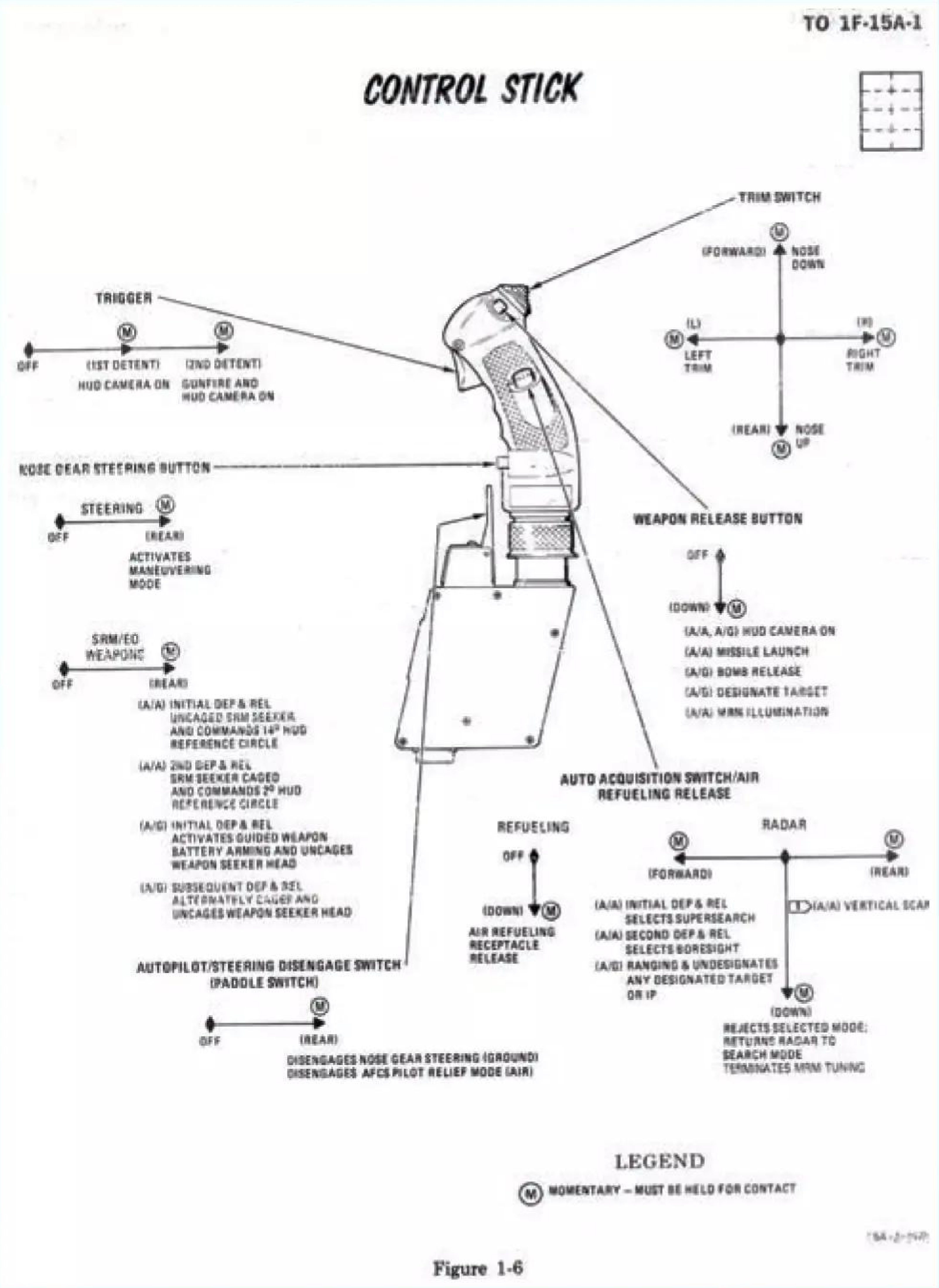
Finally it was 'Contractor A' from McDonnell Douglas. This proposal – called the 199-B – had two well-spaced engines (but not as widely spaced as the Fairchild offering) fed by two sharply-raked intakes, a bubble canopy but two vertical fins (originally the F-15 had a single fin,

➤

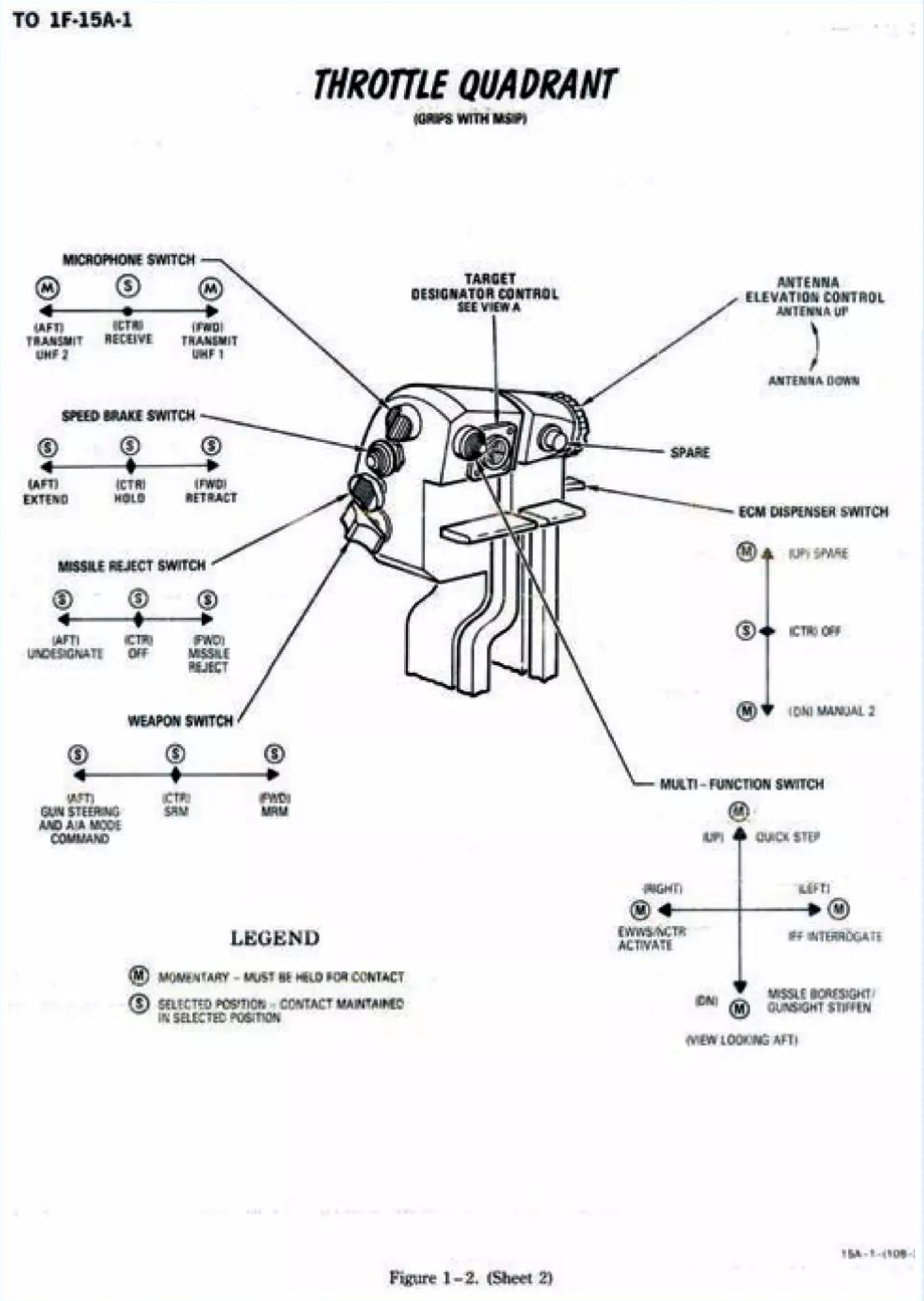


The McDonnell Douglas F-15 Eagle would eventually be built around the powerful Hughes (later Raytheon) AN/APG-63 radar.

The Eagle would feature a wide, Head-Up Display – or HUD. This system was first used on the Vought A-7 Corsair, and was going to be part of the BAC TSR.2. On the glass would be displayed important information for flight, navigation and weapons aiming.


TO 1F-15A-1
CONTROL STICK
TRIM SWITCH
(FORWARD) NOSE DOWN
(L) LEFT TRIM
(R) RIGHT TRIM
(REAR) NOSE UP
TRIGGER
OFF
(1ST DETENT) HUD CAMERA ON
(2ND DETENT) GUNFIRE AND HUD CAMERA ON
NOSE GEAR STEERING BUTTON
STEERING
OFF
(REAR) ACTIVATES MANEUVERING MODE
SRM/EO WEAPONS
OFF
(REAR)
(A/A) INITIAL DEP & REL UNCAGED SRM SEEKER AND COMMANDS 14° HUD REFERENCE CIRCLE
(A/A) 2ND DEP & REL SRM SEEKER CAGED AND COMMANDS 2° HUD REFERENCE CIRCLE
(A/G) INITIAL DEP & REL ACTIVATES GUIDED WEAPON BATTERY ARMING AND UNCAGES WEAPON SEEKER HEAD
(A/G) SUBSEQUENT DEP & REL ALTERNATELY CAGES AND UNCAGES WEAPON SEEKER HEAD
WEAPON RELEASE BUTTON
OFF
(DOWN)
(A/A, A/G) HUD CAMERA ON
(A/A) MISSILE LAUNCH
(A/G) BOMB RELEASE
(A/G) DESIGNATE TARGET
(A/A) MRM ILLUMINATION
AUTO ACQUISITION SWITCH/AIR REFUELING RELEASE
REFUELING
OFF
(DOWN) AIR REFUELING RECEPTACLE RELEASE
RADAR
(FORWARD)
(REAR)
(A/A) INITIAL DEP & REL SELECTS SUPERSEARCH
(A/A) SECOND DEP & REL SELECTS BORESIGHT
(A/G) RANGING & UNDESIGNATES ANY DESIGNATED TARGET OR IP
(A/A) VERTICAL SCAN
(DOWN) REJECTS SELECTED MODE; RETURNS RADAR TO SEARCH MODE TERMINATES MRM TUNING
AUTOPILOT/STEERING DISENGAGE SWITCH (PADDLE SWITCH)
OFF
(REAR)
DISENGAGES NOSE GEAR STEERING (GROUND)
DISENGAGES AFCS PILOT RELIEF MODE (AIR)
LEGEND
Ⓜ MOMENTARY – MUST BE HELD FOR CONTACT
15A-2-(57)
Figure 1-6

The Eagle's main control column featured many 'HOTAS' controls which kept the pilot's hands on the primary controls while altering radar range, dropping ordnance, firing missiles/gun, altering the F-15's trim as well as controlling nose wheel steering and the opening of the air-to-air refuelling door.


TO 1F-15A-1
THROTTLE QUADRANT
(GRIPS WITH MSIP)
MICROPHONE SWITCH
(AFT) TRANSMIT UHF 2
(CTR) RECEIVE
(FWD) TRANSMIT UHF 1
SPEED BRAKE SWITCH
(AFT) EXTEND
(CTR) HOLD
(FWD) RETRACT
MISSILE REJECT SWITCH
(AFT) UNDESIGNATE
(CTR) OFF
(FWD) MISSILE REJECT
WEAPON SWITCH
(AFT) GUN STEERING AND A/A MODE COMMAND
(CTR) SRM
(FWD) MRM
TARGET DESIGNATOR CONTROL SEE VIEW A
ANTENNA ELEVATION CONTROL
ANTENNA UP
ANTENNA DOWN
SPARE
ECM DISPENSER SWITCH
(UP) SPARE
(CTR) OFF
(DN) MANUAL 2
MULTI-FUNCTION SWITCH
(UP) QUICK STEP
(RIGHT) EWWS/NCTR ACTIVATE
(LEFT) IFF INTERROGATE
(DN) MISSLE BORESIGHT/ GUNSIGHT STIFFEN
(VIEW LOOKING AFT)
LEGEND
Ⓜ MOMENTARY – MUST BE HELD FOR CONTACT
Ⓢ SELECTED POSITION – CONTACT MAINTAINED IN SELECTED POSITION
15A-1-(108-)
Figure 1-2. (Sheet 2)

On the throttle quadrant you could control communications switches, radar antenna direction, ECM/chaff-flare countermeasures, target designation, weapons selection and operate the huge dorsal speed-brake.

but this was changed late in the day) as well as two, small ventral fins below. Take-off weight with four medium-range missiles was around 39,650lb but with a substantial wing area of 608sq ft and 11,400lb of internal fuel.

This design benefitted from the work done on the previous F-4, a team then led by Herman Barkey. Under his command, the design work on the F-15 for McDonnell Douglas was led by George Graff, who was appointed head of the design team. The deadline for the proposals was the end of June 1969 and McDonnell Douglas' proposal was a total of 37,000 pages that stood 11ft high! This was the end result of more than two and a half million man hours of work.

And it was a success as by December 23, 1969, McDonnell Douglas was announced as the winner. The resultant aircraft promised to be everything the F-4 was, and wasn't. In no way was the F-15 going to be a tactical strike-fighter with multirole capability (although this would be latent in the design itself as was later proved) however, it was going to have the added benefit of being able to out-manoeuvre anything in the sky thanks to that large wing and two, powerful Pratt & Whitney F100 engines. Lessons learned from Vietnam saw the inclusion of a 20mm Gatling gun in the starboard wing root, something that many USAF fighter pilots had asked for.

An interesting start to the project was that the F-15 came straight from the drawing board – there was no 'fly-off' against a rival airframe, as there often had been previously and was later. Much criticism from previous programmes (such as the F-111) meant that this way forward was to be employed: and it worked.

The McDonnell Douglas team had looked at variable geometry early on, but then rejected it down to excessive weight. Instead, a 45-degree swept wing of large surface area was to be employed (following a study of 100 different designs and a year in the wind tunnel). Surprisingly that large wing featured no high-lift devices like those seen on the slatted wing versions of the company's previous aircraft – the F-4E and S models of Phantom. In fact, an 'Agile Eagle' – a modified YRF-4C had been testing slats destined for the Eagle. Instead it was found that the wing just didn't need them, being of a highly cambered design that was extremely efficient in most regimes. Light weight was a priority, hence titanium would make up almost 26% of the airframe compared to just 9% on the F-4.

The use of an advanced radar (the Hughes APG-63 pulse-doppler 'look-down-shoot-down' unit) allowed the F-15 to be single-seat, without the separate job of radar lock and radar management to be taken on by a back-seater or 'RIO' (Radar Intercept Officer). Hughes received an $82 million contract in September 1970 to build these units.

The radar was going to be a big jump forward in capability over that seen in previous F-4 Phantom II variants. The AN/APG-63 radar would be much more adaptable and powerful than the

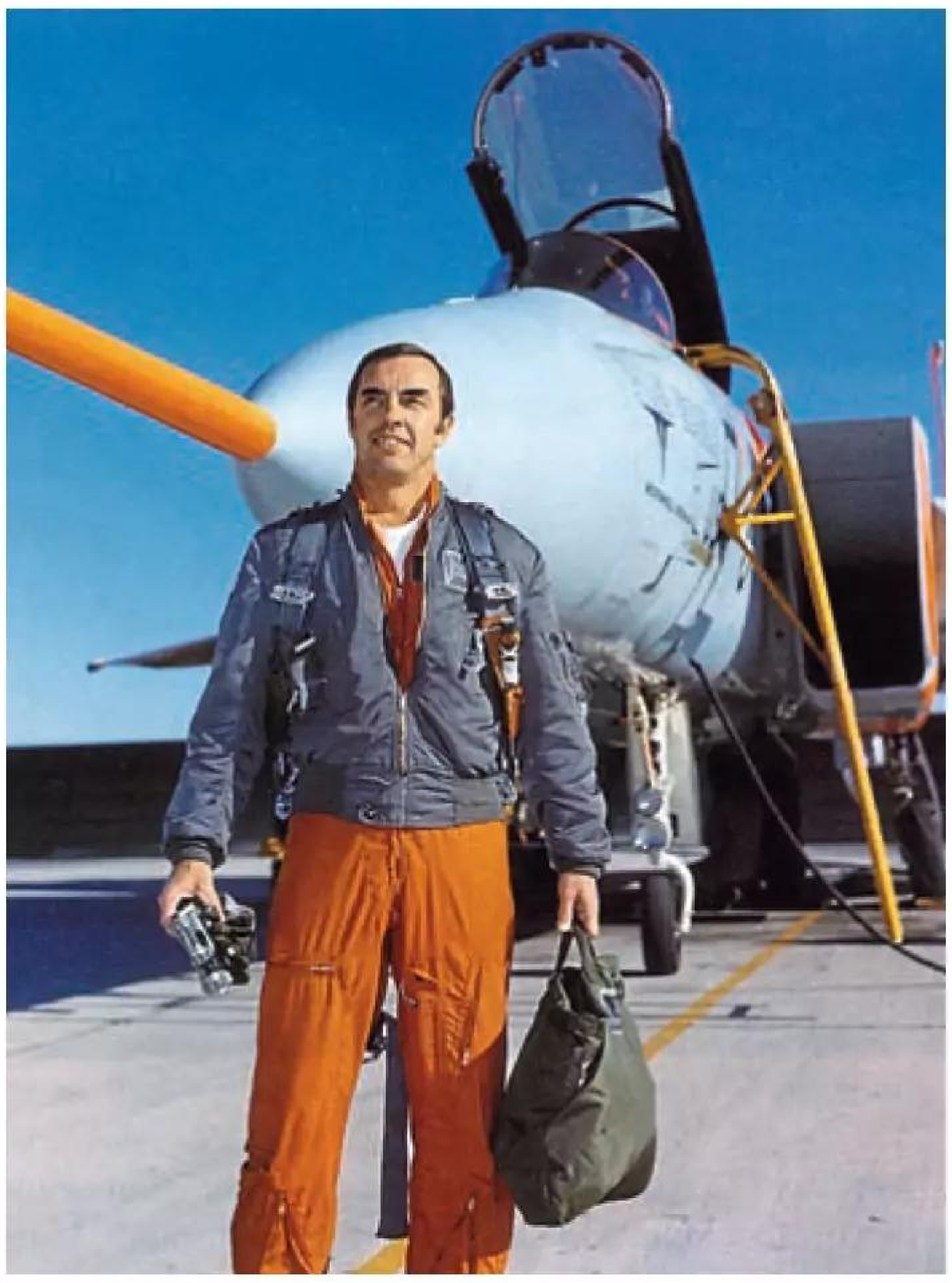
Westinghouse APQ-100/109A seen in the F-4C/D and AN/APQ-120 seen in the F-4E. While the APQs were low pulse repetition frequency radars, the APG-63 used high PRF and medium PRFs to locate and track targets even in ground clutter. The use of HPRF and MPRF also meant that the previous weak point of a pulse-doppler radar in a tail-chase, were addressed thanks to HPRF and MPRF interlocking to give a much clearer picture of the target. For ease of use, the AYK Central Computer was integrated with 13 on-board systems, including the Tactical Electronic Warfare Suite (TEWS) which meant that the computer was effectively taking over a number of the systems previously operated by the Weapons Systems Officer (WSO).

The result was a radar with almost four and a half times the search volume of the Phantom II and where the F-4 would have a 40 nautical mile search range on a fighter-sized target with a 10NM lock-up range, the AN/APG-63 gave the Eagle the eyes to detect bogeys at double that range in the 'look-up' mode or identical 40NM range in the more difficult 'look-down' mode.

Some of the systems used in the cockpit would also make things easier for the single pilot. For the first time in an out-and-out fighter, a wide Head-Up Display was used. First seen in the A-7 Corsair, this replaced the traditional 'gunsight' – instead giving vital information on the aircraft's speed, altitude and engine power as well as information for weapon deployment.

The use of a HUD would soon become de-rigueur for any strike/attack or pure fighter as would another innovation called 'HOTAS'. 'Hands On Throttle And Stick' is a system where the key controls are placed on the joystick and the throttle controls so that the pilot does not have to delve ➤

Irving 'Irv' Burrows



Irv Burrows: not only the first man to fly the F-15 Eagle, but he was an eager observer 'online' during the first flight of the 'new' F-15EX Eagle II in March 2021.

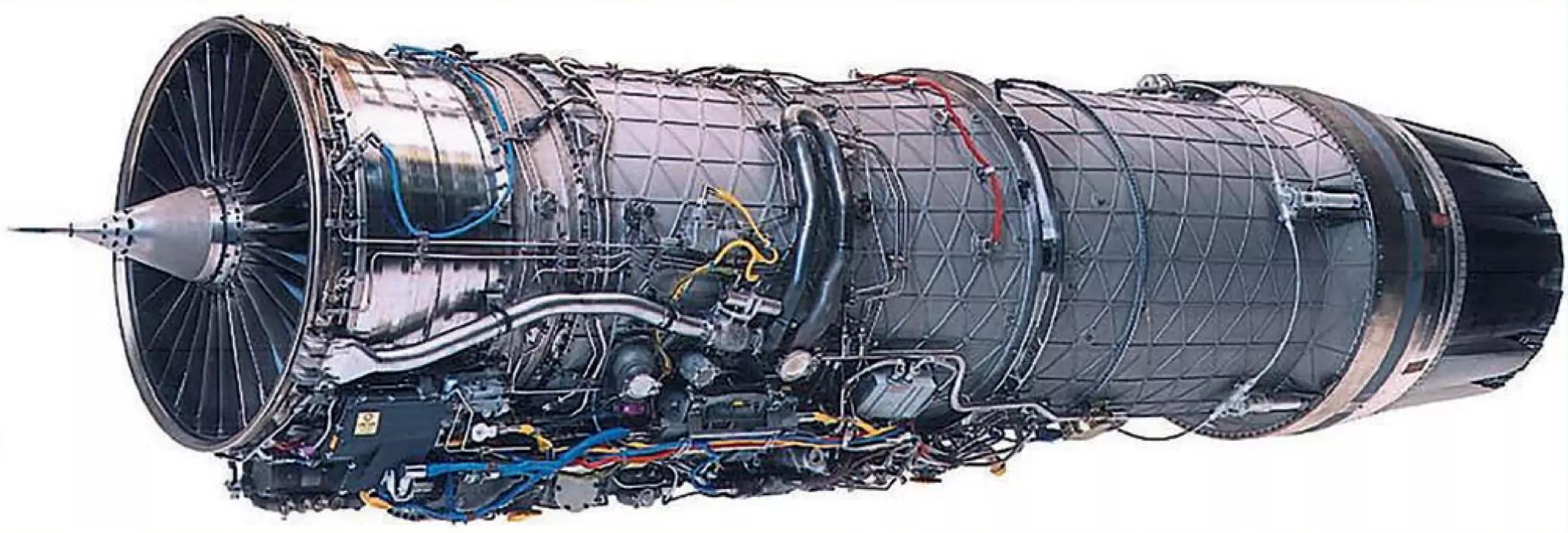
Burrows initially served in the United States Navy, began his flying career as a teenager and served in the Korean War.

In 1950, he was selected to begin training as a pilot in the USAF, graduating at the top of his class. Initially training to pilot the P-51 (by now called F-51) he was re-trained and flew the Lockheed F-80 Shooting Star and made reconnaissance flights in the North American RF-86 Sabre in Korea. He earned the Distinguished Flying Cross and two Air Medals after flying more than 100 combat missions. On leaving the Air Force he was employed at McDonnell Aircraft Company, joining the flight test department and attending the USAF Test Pilot School at Edwards Air Force Base in 1958 – the very year of the F-4 Phantom II's first flight.

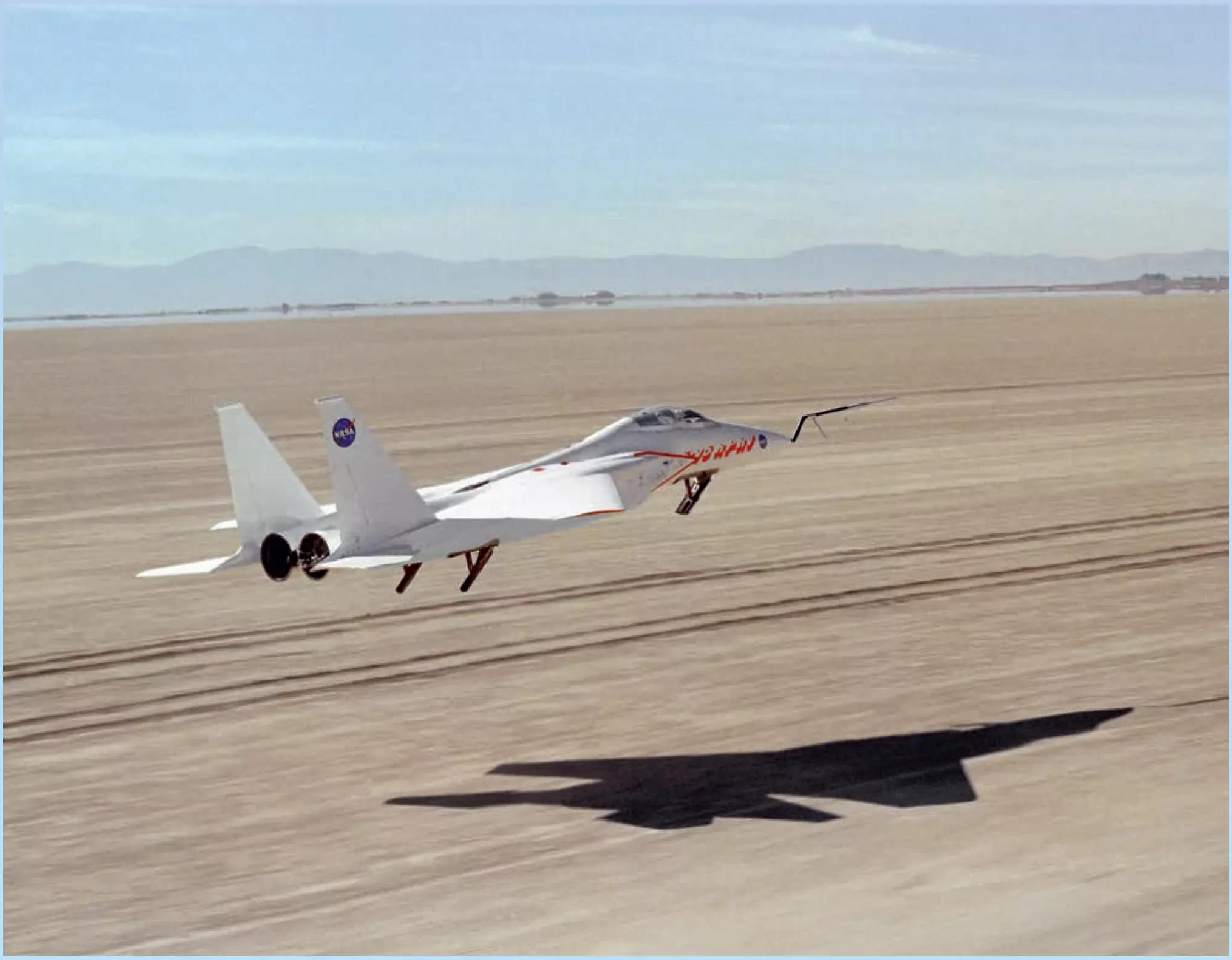
Subsequently, Irv flew diverse McDonnell types including the F-4, F-101 Voodoo and F-3H Demon before his crowning glory – being selected as Project Pilot for the F-15 Eagle Programme.

Irv has many awards to his name, including the Ivan C Kincheloe trophy by the Society of Experimental Test Pilots as 'Test Pilot of the Year' for his work on F-15 programme (1974) he was made a fellow in the Society of Experimental Pilots in 1972 and served as its president in 1977. In 1989, the society presented him with the James H Doolittle Award while in 1984 he received the USAF Test Pilot School Distinguished Alumni Award in recognition of his work in flight test.

He retired from test flying in 1976 then held several positions at McDonnell eventually serving as executive vice president. Burrows continued to fly recreationally for a number of years after retiring from test flying and he retired from McDonnell in 1991.



After initial issues, the Pratt & Witney F100 turbofan became a byword for reliability.



Costing just $250,000 each, these 3/8th scale ‘F-15s’ would garner a wealth of aerodynamic information during testing from 1973 after being dropped from a Boeing NB-52.

down into the cockpit for a vital switch when flying the aircraft.

Linked with the HUD it allows the pilot to perform all the basic functions of air combat without removing his hands from stick or throttle or go ‘heads down’ in the cockpit. The idea was first used in the BAC Lightning, where some controls for the Ferranti AIRPASS radar/gunsight were placed on the hand controls but this system was refined still further for the F-15 and subsequent fighters.

With each different aircraft, the buttons would do different things – for example the later F-15E Strike Eagle would be able to control any sensors such as the Forward Looking Infra-Red systems (FLIR). But generally, HOTAS-equipped fighters would have a ‘coolie hat’ atop the main joystick to help with trimming the aircraft, a trigger for weapons firing (normally cannon/air-to-air missiles) another weapons release button near the coolie hat for air-to-ground ordnance. Other buttons and levers would either engage or disengage the auto-pilot, open or shut air-to-air refuelling doors and engage/disengage nose-wheel steering systems.

On the throttle quadrant, comms/microphone switches, the airbrake, the moving/slewing of the radar antenna, weapons selection and electronic countermeasures could be controlled/ejected. To add yet more functions, switches could be held on, or ‘rocked’ to add more complexity. While the HUD/HOTAS combination was a great move forward for the fighter or attack pilot to keep his or her ‘situational awareness’ outside of the cockpit, one F-15C pilot remarked to the author that: *“You soon get used to it in the simulator and in the plane itself so that you have the manual digit dexterity of a piccolo player!”*

First-flight pilot Irving Burrows said in a 2003 interview: “As test pilots at McDD our staff had a small part to play in those early days – but we’d like to think an important one. We had assigned a team to work within the company, and with the customer when appropriate, to help make our version of the F-15 the best ‘pilot’s’ airplane. Individual test pilots were assigned to areas including cockpit design. One of the products of this process was the development of the HOTAS system. We called this system ‘Hands On Throttle And Stick’ since the pertinent switches were all incorporated on the throttles and control stick. It was to become the model for cockpits in all subsequent fighter planes.”

Armament was to be what went before but with a big difference – advanced versions of the AIM-7 Sparrow (which had proved to be such a disappointment in Vietnam) would be semi-recessed along the corners of the intake trunks, while four short-range infra-red guided air-to-air missiles – the ubiquitous AIM-9 Sidewinder – would be placed on inner

The need for a gun

The cannon was ruled out of the designs of the original McDonnell F-4 Phantom in the early-mid 1950s, when it was thought that a full air-to-air missile armament would be the future.

The air war over Vietnam, even by the early part of that conflict, had shown this was nonsense, even if the cannon-armed F-8 Crusader was taking down more bogies with Sidewinders than 20mm slugs from its four cannon.

For the USAF's F-4Cs and Ds, the only recourse was to use podded cannon – the SUU family – which replaced the centreline tank on the F-4C and D. The USAF began to use the SUU-16/A on the F-4s from May 1967 and the change it brought was almost instant. On May 14 – a day after an F-105 had destroyed a MiG-17 with cannon-fire – aircrew from the 366th TFW destroyed three MiG-17s – two of them with the podded cannon and after initial missile shots had missed. The pods had proved their worth.

By 1967, the ultimate fighter incarnation of the venerable Phantom II was already on its way for the USAF in the shape of the F-4E, which had – beneath the radome – the same 20mm GE Vulcan cannon. Eventually in Vietnam, the F-4C and D models took down 10 MiGS with podded cannon, the F-4E shot down five enemy aircraft with the internal M61 while the F-105 took down three MiGs (one of which was shared with an F-4D) and even the B-52 bomber shot down two MiGs with its tail barbette of four 0.5in machine guns.

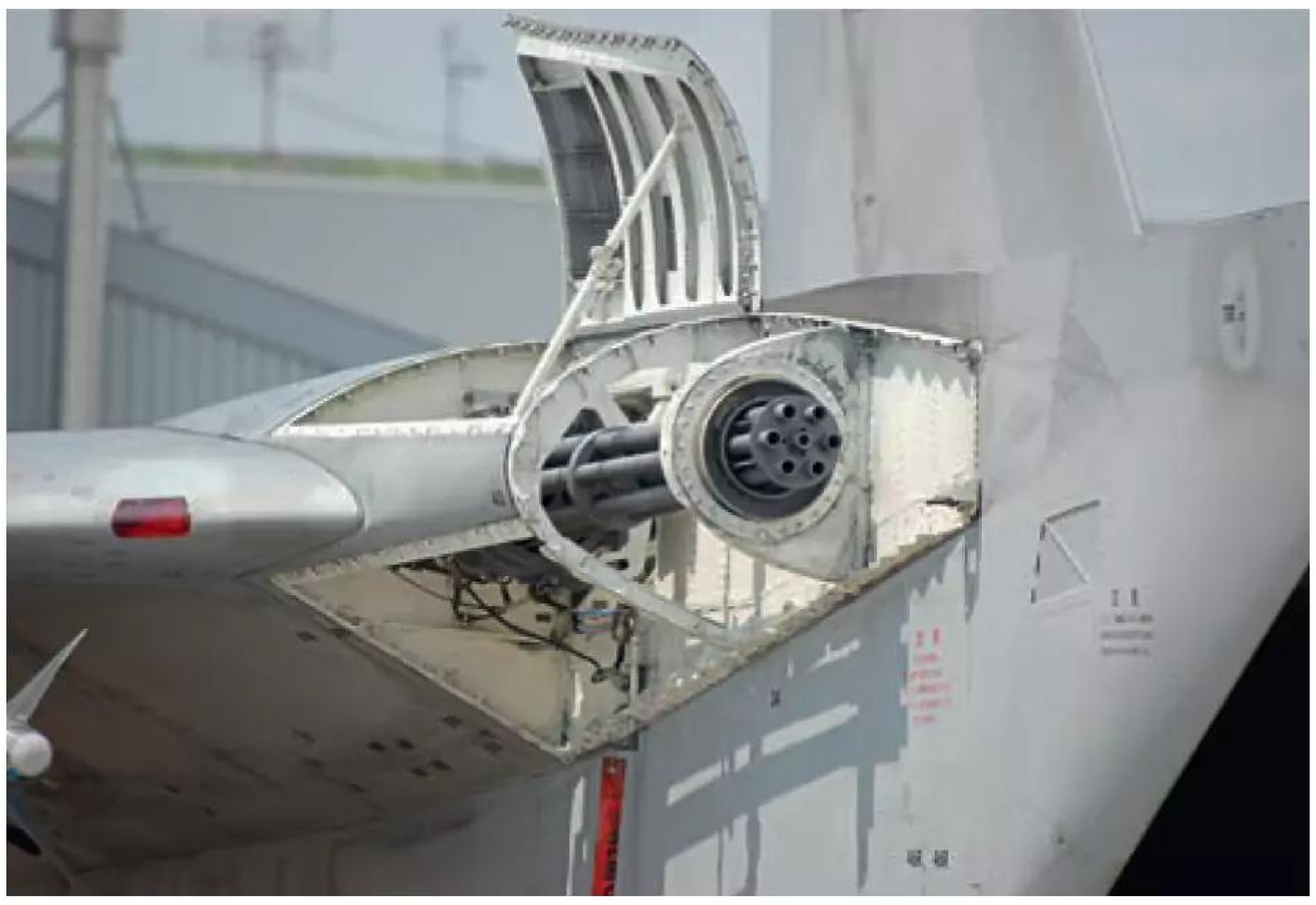
Other improvements came as a result of The Red Baron Reports and the Ault Report, where the lack of dogfighting skills/tactics in both USAF and US Navy doctrine was criticised – along with brochure performance rates of air-to-air missiles compared to actual combat conditions. This would lead to the formation of the Navy Fighter Weapons School, known more famously as TOPGUN and – thanks to Red Baron – the Red Flag series of exercises and the beginning of the Aggressor Squadrons, where experienced, highly-trained pilots in the art of dogfighting would aim to pass on hard-earned lessons to the pilots at squadron level.

Thanks to Vietnam, the gun was back in fashion and it would be included on the F-15 Eagle. Initially it was to be a 25mm gun that would use caseless ammunition. A competition between Ford-Philco and General Electric saw the former company awarded a contract for what was called the GAU-7/A.

This was to be a revolutionary gun as – using telescoped ammo with a combustible casing – it was to have longer range, higher velocity (and therefore hitting power) and a flatter trajectory than the faithful old 20mm shell. Using a combustible casing means you don't have to have a system for ejecting the spent cartridges, or keeping them on the aircraft.

Sadly, by 1973 issues had been raised. The caseless ammunition would prove to be troublesome with some rounds exploding before being fired, meaning that the cannon fitment – on the F-15's starboard wing – and the ammo tank (stored in a vertical 'bin' arrangement below the dorsal air-brake) had to be reinforced and lined. More than $100 million had been spent on the GAU-7 without clearing these issues and it was in 1974 that the Eagle was to return to the tried-and-trusted fitment of the 20mm M61-A1 Vulcan cannon, that had seen service in the US since the introduction of the F-104 Starfighter back in 1956.

Since then, cannon have been an integral weapon on most fighter and attack aircraft including the latest F-35 Lightning II and have proven their worth in air-to-ground missions in Iraq and Afghanistan – even if the last air-to-air guns kill was recorded in 1988.



The neat wing-root home for the Vulcan 20mm cannon was much better than the podded versions seen on earlier F-4s....

wing pylons. The one big change from the early versions of the F-4 Phantom II would be the inclusion of an internal gun. The General Electric 20mm M61-A1 cannon had seen service since inclusion on the (ironically) poor dogfighter that was the Lockheed F-104 Starfighter.

Despite the initial decision to develop a newer more refined cannon, the Vulcan was eventually used on the fledgling Eagle. This 'gatling gun' was to be installed in the starboard wing leading edge together with 940 rounds of ammunition. Range was also to be important in this big fighter, so provision was made for the carrying of three 610-gallon drop tanks or up to 9000lb of air-to-ground stores: although the air-to-ground role was only secondary for the F-15 at this time.

Pratt & Whitney power

The engines that would power this fourth generation fighter would eventually become the safest ever used by the USAF. Like the Eagle itself, the F100 can trace its roots back to the 1960s.

In 1967, there was a joint request from the Navy and Air Force for a new engine to power both the F-X (F-15) and the new Grumman F-14 Tomcat. While the USN (perhaps foolishly as it turned out) cancelled their requirement and continued to use the P&W TF30 in the F-14, Pratt & Whitney won a lucrative contract to develop the F100-PW-100 for use in the Eagle.

Like the TF30, the F100 would have its own early share of issues as it was developed for use in the F-15 and (in dash-200 form) for the F-16 Fighting Falcon. High ➤

Irv Burrows about the make that first, historic flight in 1972.

F-15 EAGLE
MCDONNELL DOUGLAS
USA

wear was initially found, with some aircraft shedding blades. Poor afterburner light-up times were found too as well as another problem with the 'turkey feathers'.

On early F-15s (and later, the Rockwell B-1B Lancer's General Electric F101 engine) it was found that the metallic plates that covered the intricate workings of the engine's nozzles, called 'turkey feathers', sometimes came off the aircraft during flight due to vibration issues. The easiest way to solve the problem was to simply remove the 'turkey feathers' which happened in the early 1980s. Over successive generations of the F100 motor, all these issues were solved – hence later models of the F-15/16 powered by the 200/220/229 series of the family had their turkey feathers restored. Since then, the F100 has become a byword for turbofan engine reliability.

Model magic

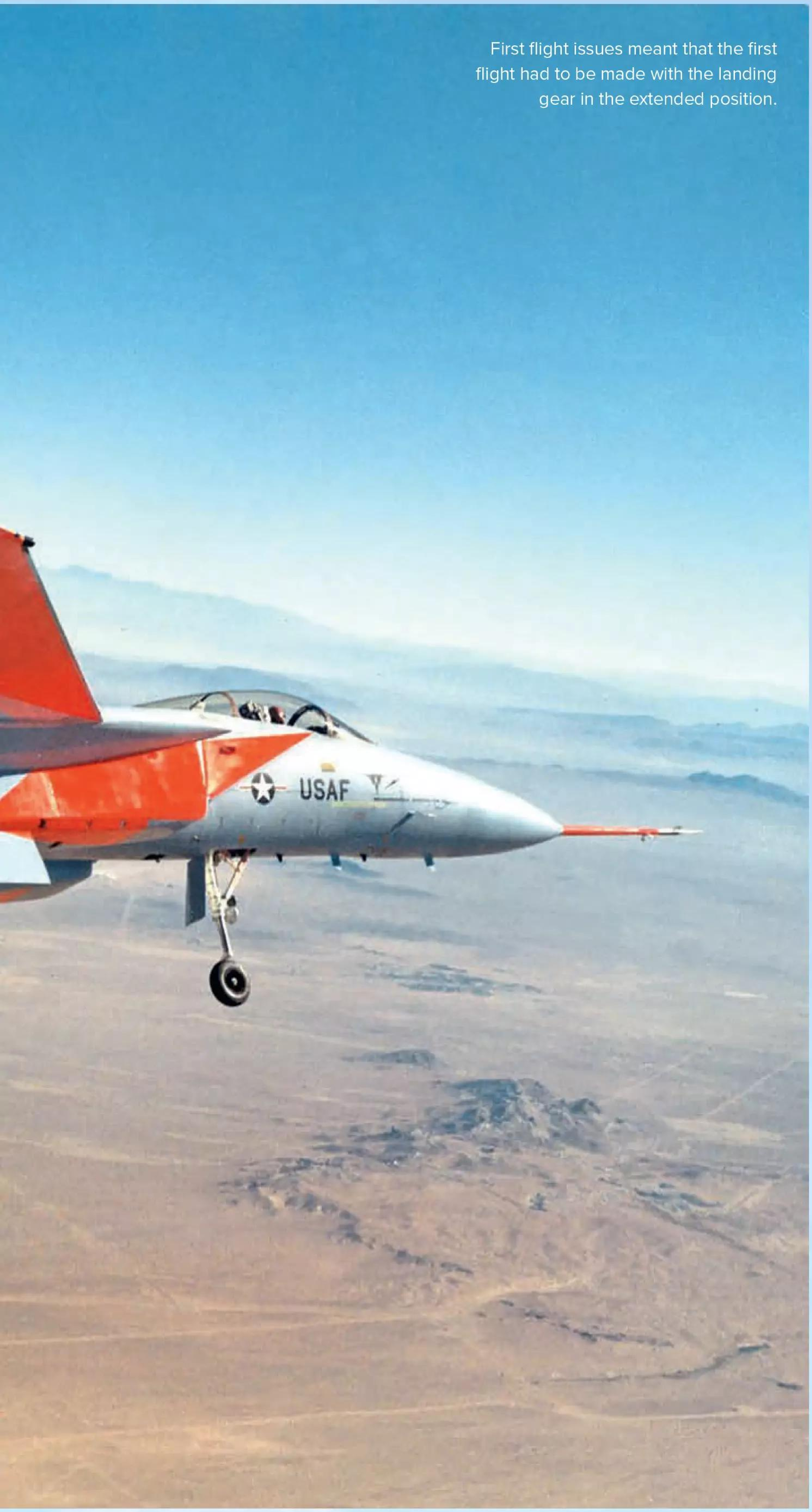
Usefully for McDonnell Douglas, a three-eighths-scale 'Remotely Piloted Research Vehicle' would prove its worth in demonstrating the general design of the F-15 – but only 'after' the full-sized machine's first flight!

In November 1971, NASA approved flight research for the F-15 RPRV. It would measure 23.5ft in length and have a 16ft wing span and be recoverable in mid-air by helicopter. As a back-up to the long work done in the wind tunnel and on the full-size prototypes, this RPRV would feed data to the test team on basic handling as well as information on high AOA (angles of attack) agility of the F-15. These (relatively) cheap aircraft cost just $250,000 each, were made from fibre-glass and were unpowered. The project was backed up by a wealth of technology and facilities to get the most from the information garnered by these models.

Interestingly, these models were not to precede the flight of the main prototype, but instead increase the amount of data in a safe and controlled manner and carry a number of sensors and television cameras.

The first F-15 RPRV arrived at Dryden's Flight Research Center in December 1972 but didn't fly until October 12, 1973. The model was carried to an altitude of around 45,000ft beneath the wing of a modified NB-52 Stratofortress. Following release, ground pilot Einar Enevoldson guided the craft on a 10 minute flight which explored the McDonnell design's handling qualities, before being picked up by helicopter and lowered to the ground. ➤

USAF
10280
F-15


First flight issues meant that the first flight had to be made with the landing gear in the extended position.

This helped development as it meant that during risky spin-testing the RPRV enabled the pilot to get a feel for how the basic F-15 airframe behaved, while not risking a $7 million full-sized aircraft. It made around 27 flights between 1973 and 1975 during early testing of the F-15 and explored many areas of the F-15's aerodynamic envelope, eventually carrying on until 1981 by which time 53 flights had been made.

Roll-out, first flight, first glitch

To say that the F-X/F-15 programme was a 'big deal' for McDonnell Douglas was an understatement. The USAF was going to buy 749 F-15 Eagles, but before it became a fully-fledged production fighter, 12 F-15s would be used as Category 1 test planes, then, eight would be Cat 2 – later to be upgraded to operational aircraft, although this never happened.

The first F-15A prototype was built alongside the very F-4s it was designed to replace: F-4s that would see combat across the world. The Phantom II had become a global aviation phenomenon by the early 1970s and was the weapon of choice for the free world – more than 5,000 would eventually be built. Would the fledgling F-15 garner as much success?

As the weeks and months rolled on, various 'firsts' were reached. Come February 1972 and the F100 engine had completed 60 hours of testing, while the structural tests of the major sub-assemblies of the F-15 itself were completed some months ahead of schedule.

On June 26, roll-out showed this big new fighter to the world for the first (official) time and painted in air-superiority blue it looked the part. Burrows recalled: "This day in June I started up the engines and taxied out from our hiding place behind one of the hangars to a spot on our ramp in front of the crowd of company and USAF people and guests. A champagne bottle was swung very carefully by the wife of the assistant secretary of the Air Force and with the appropriate speeches the F-15 finally became the 'Eagle.'"

The aircraft was then dismantled and flown in a Lockheed C-5A Galaxy to Edwards Air Force Base in California ready for its first flight. The pilot of which – Colonel Jesse Jacobs – would later remind Burrows that it was he who was the first man to actually get an F-15 airborne.

Irrespective of the F-15's first flight in the hold of a C-5A, many McDonnell Douglas pilots had 'flown' the Eagle in the simulator. This was – for the late 1960s/ ➤

early 1970s – pretty new tech. Irv Burrows said: "One of the tools we used extensively was the simulator. This was a cockpit built to scale with as much realism and accuracy in it as possible, but it was stationary inside a building. The instruments inside provided feedback to the pilot who was 'flying' the simulator: typically the cockpit was inside a large dome, on the walls of which could be projected clouds, the ground and even another airplane.

"The pilot could then fly the simulator in any number of tasks, from take-offs and landings to dogfights with other aircraft (flown by a computer or another pilot). Back in those days our simulator facility was on the cutting edge of technology. We test pilots spent a lot of time over there as did some of our USAF counterparts."

The use of the simulator didn't just give the test pilots the 'feel' of the real Eagle and how it might perform it also helped develop systems, switches, cockpit layouts and the like for the production aircraft to come.

The aircraft that was to be the first Eagle in the air was serial number 71-280 and it was the culmination of many years of work but it was still – effectively – the 199-B which won the contract back in 1969. Refinements were few, but gone were the ventral fins and in came larger main vertical fins. NASA (which worked with the USAF during selection as well as independently evaluating the designs) noted that subsonic drag was higher than originally thought, so the design change removed the ventral fins and subsequently added the needed area above.

By the time of the scheduled first flight – July 27 – the Eagle had gained day-glo wing tips, tails and intake trunks and a pitot/test boom on the nose. In a 2003 article first flight pilot Irv Burrows talks about the run-up to that fateful day: "Joe Dobronski, my boss and chief test pilot assigned me as first-flight pilot: a wonderful opportunity for me," explained Burrows. "There isn't a test pilot in the business who would not jump at the chance to make the first flight in a newly-developed airplane. My good friend Pete Garrison would be back-up pilot in case I broke my leg skiing or some such thing!"

For Irv, thoughts were already on him flying a new airframe *and* new engines, as – by that point in time – it was hoped that the F100 would have been flying in the F-14 Tomcat, if only the Navy hadn't pulled out of the joint engine programme… Burrows remarked: "So, we'd be flying a brand-new airplane with engines that had never been developed through airborne testing. That's why we made the first flight at Edwards, just adjacent to the dry lake, Muroc Lake, which provided us with a ten-mile long emergency runway – should we need it."

With much of his huge experience on the F-4 Phantom over the previous decade, on the run-up to the first flight Irv managed to get (with USAF approval) a number of flights on other aircraft, such as the F-104 Starfighter, the Northrop T-38 Talon, as well as McDD's own A-4 Skyhawk: "Pete and I did this as we believed we needed to expand our horizons a bit and prepare for a new and different cockpit and airplane feel." More time in the simulator would copy exactly the first-flight profile.

At around 7am on the morning of July 27, 1972, Burrows climbed into 71-280 after a long, detailed walk around the aircraft, before which the twin F100 engines had been spooled-up, with the aircraft restrained and chained to the ground. Helping him strap in was Glenn Lewellyn, an inspector on the project. Most of the team from McDonnell Douglas were based about 40 minutes away and they had left at around 4am to get the F-15 ready for this historic moment. Burrows would be 'chased' by his good friends Pete Garrison and Colonel Wendell 'Wendy' Shawler – who would later be the first USAF pilot to fly the Eagle and the first-flight pilot of the A-10B Night/Adverse Weather Thunderbolt II two-seater. Both flew in F-4 Phantoms with a cameraman in the rear seat.

Burrows placed 71-280 at the end of the Edwards runway and unleashed the power of the F100s with his left hand. This was maximum 'dry' thrust without afterburners, so this meant the pilot would get a good feel about the aircraft on take-off and learn something about its behaviour. The aircraft then jumped into the air for its first 50 minute (or so) flight. During which time the Eagle got to 12,000ft and a max speed of 320 miles an hour.

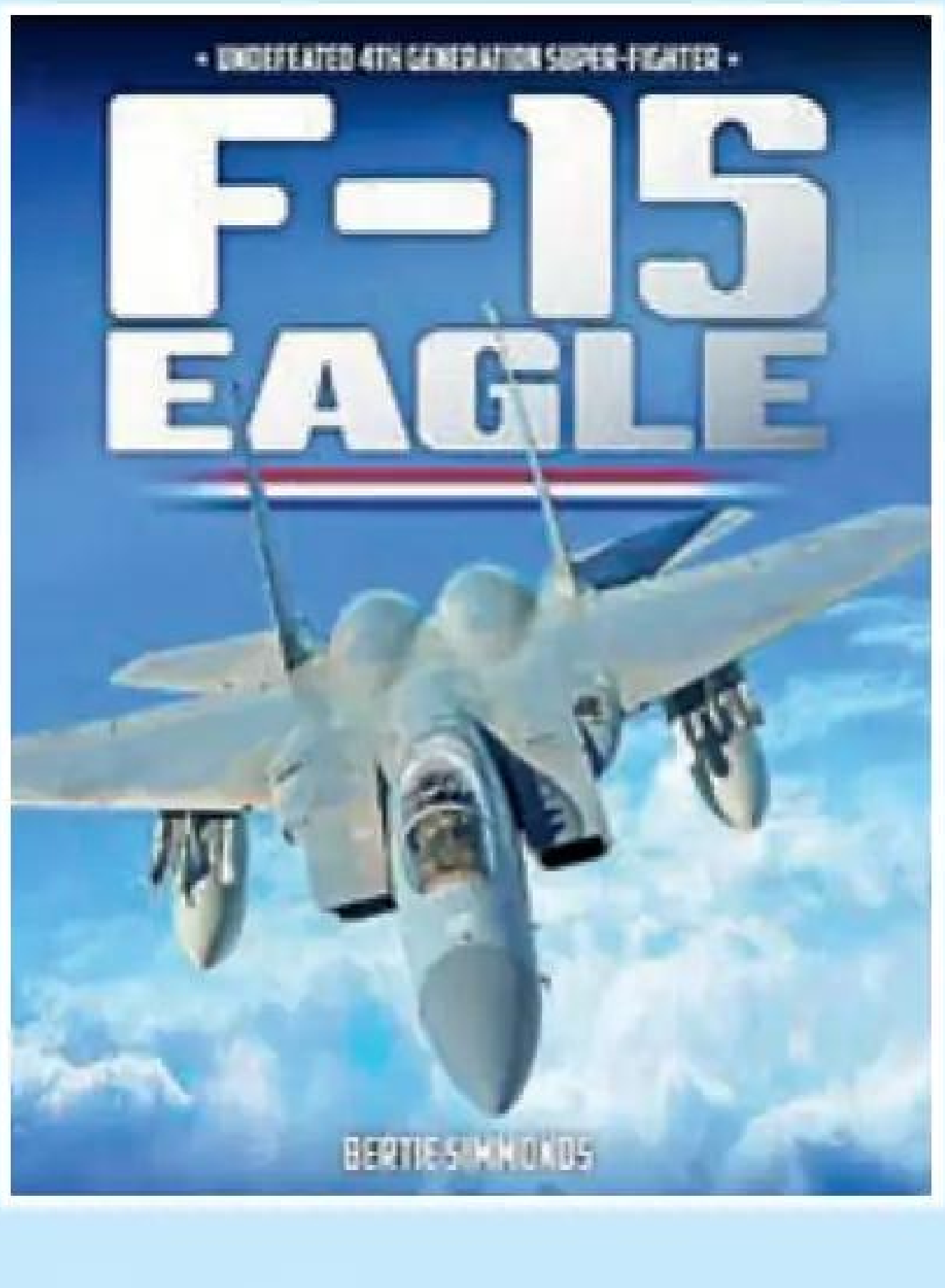
But it wasn't without incident. Burrows: "So off we went – a comfortable take-off and impressive performance to around 2500ft. Then came the only glitch in the first flight. When I retracted the landing gear a red light in the cockpit told me that all was not right. Either Pete or Wendy moved in close enough to see that one of the doors that closed over the gear when retracted was not closed flush. Enter plan B: after extending the landing gear (and heaving a sigh of relief that all three wheels were going to be in the right place for landing) we proceeded with the back-up plan – a test flight with the wheels down.

"Over the next hour or so we were able to accomplish a lot – handling quality checks on both the airplane and engines up to 15,000ft or so, speed brake extensions (during which we experienced too much buffet) practice landing approaches to get a feel for a good approach speed and afterburner light-ups and shut-downs on each engine. We were able to compare the airplane's flying qualities with that of the simulator and found that the correlation was quite good. The airplane 'felt good' the visibility from the cockpit was spectacular, the response to control movement was quick and precise and the power from the engines was impressive. Bob Little, who as chief test pilot for McDonnell back in 1958 had made the first flight on the F-4 Phantom II, once told me: *'I knew it was a winner.'* I felt the same about the Eagle."

Burrows made the landing approach at around 170mph, made a gentle touchdown with the dorsal airbrake only half extended. He held the nose-wheel up until the Eagle was going quite slowly before letting it kiss the ground. All three wheels were down and the first flight had been a success. After touchdown the canopy cracked open and Irv got out: giving a 'thumbs up' sign to the waiting McDD crew and staff. For the Eagle, it was an auspicious beginning and the test schedule was going to be a busy one.

The flight test programme continued on schedule without any major issues through to the F-15's 1000th flight in November 1973, by which time the Eagle had really spread her wings, flying at over 60,000ft and reaching a top speed of Mach 2.3.
The Eagle had finally flown the nest. ■

For more, see:
F-15 EAGLE
Undefeated 4th Generation Super-Fighter
By Bertie Simmonds
Published by Mortons Media Group
Price on Amazon (Hardcover £12.49)



George Kemp Gilroy

DSO, DFC & Bar

(1 June 1914 – 25 March 1995)

Born in Edinburgh in 1914, George' Sheep' Gilroy worked as a sheep farmer after leaving school before joining the Royal Auxiliary Air Force in 1938. He was commissioned as an acting pilot officer in 603 Squadron that same year.

Following the outbreak of the Second World War, he was one of the first Spitfire pilots to see action, his aircraft being hit by a single bullet from an He 111 rear gunner on 16 October 1939, during a skirmish.

More encounters followed and by 24 July he had shared in the shooting down of five German bombers. In August his unit moved south and he claimed two Messerschmitt Bf 109s later that month.

On 1 September, Gilroy was shot down by Messerschmitts and managed to bail out of X4271 over Ilford and was slightly wounded. On landing he was mistaken for a German and the local Home Guard attacked him before realising his identity when he was then taken to hospital.

Back with the squadron, he was awarded the Distinguished Flying Cross (DFC) on 13 September. He claimed another Bf 109 and a shared He 111 before being injured when another Spitfire collided with his during a formation landing. He returned to operations in February 1941 and took command of 609 Squadron on 19 July.

Gilroy had more successes with this unit shooting down four more German aircraft, before being posted away at the end of May 1942. In the June, Gilroy added a bar to his DFC.

George 'Sheep' Gilroy.

In November 1942, Gilroy was posted to 325 Wing in East Africa and at the end of the month took command of 324 Wing on the Tunisian Front. He gained more victories, but on 28 January 1943, Gilroy was in a collision with Flight Lieutenant E B Mortimer-Rose over the unit's airfield at Souk-el-Khemis resulting in both aircraft crashing. Gilroy managed to bail out with minor injuries but Mortimer-Rose was killed.

Gilroy continued to lead 324 Wing during the invasions of Sicily and Southern Italy, remaining with the unit until November 1943.

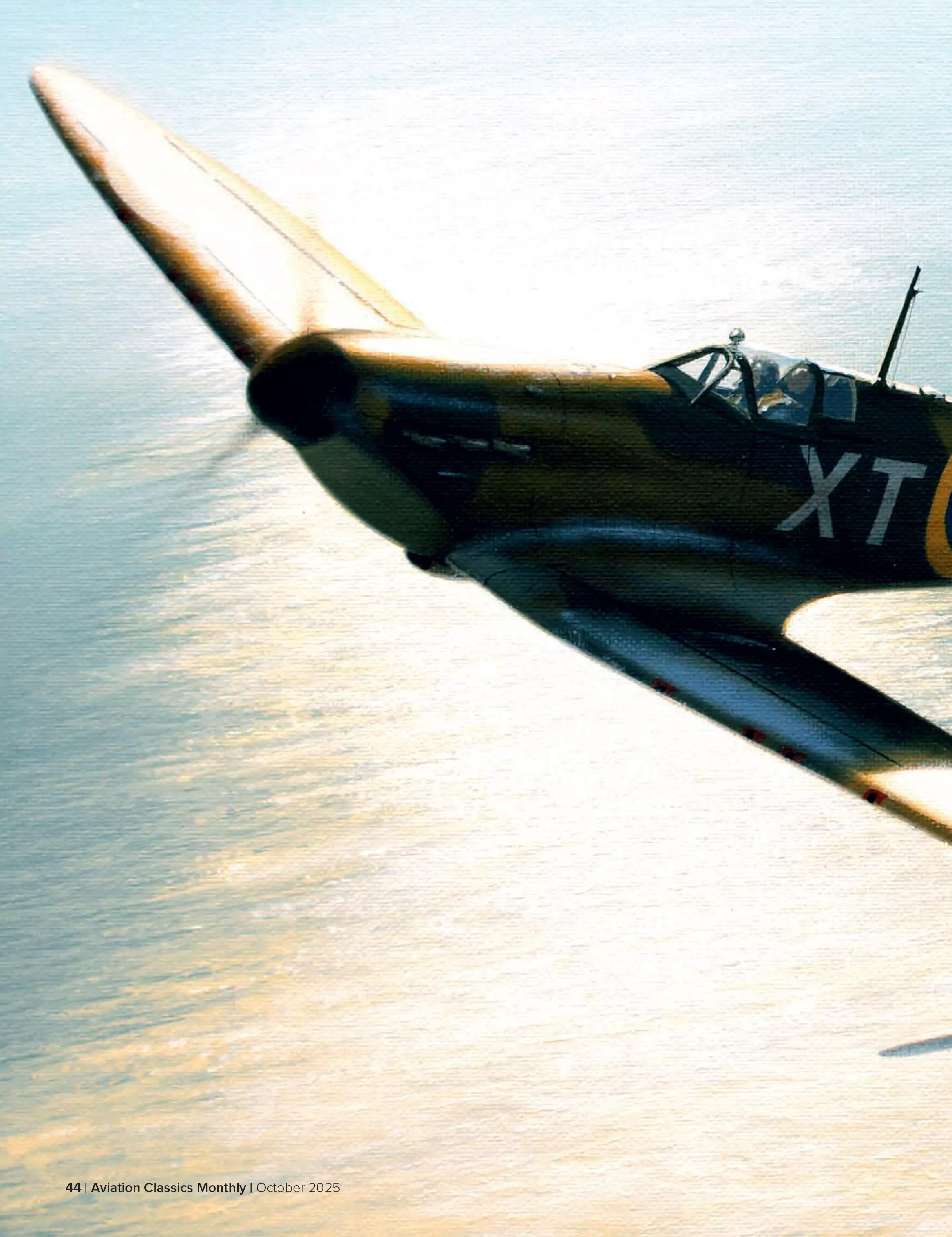
In February 1944, Gilroy added a Distinguished Service Order (DSO) to his decorations. He returned to the UK late in the year and was promoted Group Captain, commanding Wittering and then Blakelow airfields. Adding to his decorations in November 1944 with a US DFC.

Flying with 603 Squadron, Gilroy shared in eight aircraft destroyed and claimed three victories of his own. With 609 Squadron he claimed four more victories and moved on to 324 Wing. He was finally credited with an overall total of 14 personal victories and 14 shared.

At the end of the war, he rejoined the RAuxAF becoming commanding officer of his old 603 Squadron from June 1946 to September 1949.

Gilroy returned to sheep farming in his native Scotland and died in 1995.

See a tribute to George Gilroy on the following centrespread courtesy of Ivan Berryman. Titled 'Tribute to George Gilroy, Channel Skirmish'. ■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IVAN BERRYMAN

Russia's answer to the Boeing B-47

Between 1947 and 1950, British and American manufacturers made significant progress in supporting the national commitment to develop long-range bombers and establish the credibility of the atomic bomb, both as a deterrent and as a means of retaliation. For a while, each side only had tactical or medium-range jet bombers, which were not sufficient for long-range strategic missions. However, this was about to change as David Baker explains…

The US Air Force had the North American B-45 Tornado in the air in March 1947, followed within two years by the British with the English Electric Canberra, jet-powered medium bombers in the same category as the Ilyushin Il-28. More worrying for the Russians was the flight of the Boeing B-47 in December 1947 with a combat range in excess of 3,000km (1,864miles) carrying a 9,072kg (20,000lb) bomb load. With a top speed of 977kph (607mph) and a cruising speed of 896kph (557mph), the B-47 was a formidable threat, especially so, when deployed to forward bases.

The formation of the North Atlantic Treaty Organisation (NATO) in April 1949 consolidated a hitherto relatively loose and fragmented trans-Atlantic alliance which saw the return of US forces to Western Europe. The Berlin airlift of 1948-49 cemented concern regarding Soviet ambitions and this catalysed a Western response. The perceived threat from the Soviet Union through its permanent occupation of East European countries pushed that military coalition to which the Russians would respond with the establishment of the Warsaw Pact in May 1955, eight countries being signatories including Russia.

Long before the establishment of the Warsaw Pact, however, the deployment of long-range strategic bombers by the US and Britain had become the underpinning incentive for Russia to speed up development of its own fast, jet-powered bomber force. Flown for the first time in 1951 and 1952, the British V-bombers (Valiant, Victor and Vulcan) were known by the Russians to be in full-scale development by the end of the 1940s while the Americans were in the process of transitioning to an all-jet, strategic bomber force. The Boeing B-52 made its first flight in 1952, signalling a significant increase in strike capacity and, with long range, capable of hitting any target in the Soviet Union.

The detonation of the first Soviet atom bomb in August 1949, was followed by the first British A-bomb detonated at Monte Bello in October 1952. That was followed a month later by the first thermonuclear 'hydrogen' bomb, detonated by the United States in a ground test. After several years of hybrid fission/fusion development and testing, the Russians had their own H-bomb in November 1955, dropped from a Tu-95. In the ten years since the end of the Second World War, the potential threat to global stability had been upended by the convergence of atomic physics and nuclear engineering.

All these factors, both threats and technological developments, were well known to the Russians in the latter years of the 1940s and fervent efforts were introduced to provide the long-range air force with suitable jet-bombers for strategic operations. The Il-28 was at best a medium bomber but the real need was framed by the encroaching NATO forces encircling the Soviet Union and, to the Russians, an apparent threat. It was the impending appearance of the B-47 that accelerated development of a strategic, jet-powered bomber and that involved a crash programme while accelerating development of the jet-powered Myasishchev M-4 and the turboprop-powered Tu-95.

Before those emerged, a wide ranging programme of aeronautical research began at TsAGI, particularly on swept-wing designs which were considered crucial to the performance of long-range aircraft. A wide range of questions remained about the entire aerodynamic design philosophy for jet aircraft and the development of powerful and reliable engines. The legacy first-generation powerplants obtained from the British had been a useful starting point but, combined with existing Russian work on new jet engines, progress was being made toward a new generation which called for extensive testing.

Known for its large aircraft, Tupolev guided OKB-156 research by combining the expertise at Tsentral'nyy Aerogidrodinamicheskiy Institut, (TsAGI) Russia's national research centre for aviation, with practical results from swept-wing fighter design such as the MiG-15 and -17 fighters. Progress with the latter had

The three aircraft that worried Russia the most during the early years of the Cold War: the USAF's B-45; the British Canberra, this example bought by the Americans for adaptation as the B-57; and the Boeing B-47 swept-wing bomber. *(USAF)*

introduced a thinner wing with greater sweepback for improved aerodynamic performance. Tupolev wanted to see whether those same characteristics would work on larger aircraft. In particular, Tupolev was intrigued by the double sweep on the wing leading edge, graduating from 45deg at quarter-chord to 42deg outboard. On the MiG-17 this introduced a stiffer wing which maintained wing loadings and symmetry at high stress levels and during manoeuvres.

Working alongside TsAGI, Tupolev began to short-list wing designs through a range of planform options presenting a sweptback leading edge of 35deg and aspect ratios between 6 and 11. But there were problems for the stress engineers in the structural strength of the root. It appeared that in the familiar two-spar design, the forward spar would be longer than the other and carry the greater load. Load-carrying and stress factors were of great concern and much time and effort was expended on studying the stress flow in the centre-section box structure.

The aircraft emerging from this work was the Tu-82, or Aircraft 82, from which would evolve a range of evolutionary concept designs of which none flew. But the Tu-82 was powered by two RD-45F or VK-1 turbojet engines with a projected top speed close to Mach 0.95. It was in fact a completely revised configuration from Aircraft 73 which had been the progenitor of the Tu-14, a tactical bomber which made its first flight on 13 October 1949, and which was the serious competitor to the Il-28.

The Tu-14 had straight wings but the pressure to get a bomber with swept wings and a better performance pushed Tupolev to use this airframe as the basis for the new design. The Aircraft 73 concept began as a proposal with three engines: a single Nene engine under each wing and a Derwent V in the tail, but the availability of the more powerful Klimov VK-1 removed the need for the Derwent. This switched designations to Aircraft 81 which formed the basis for the Tu-14. Around 150 were produced

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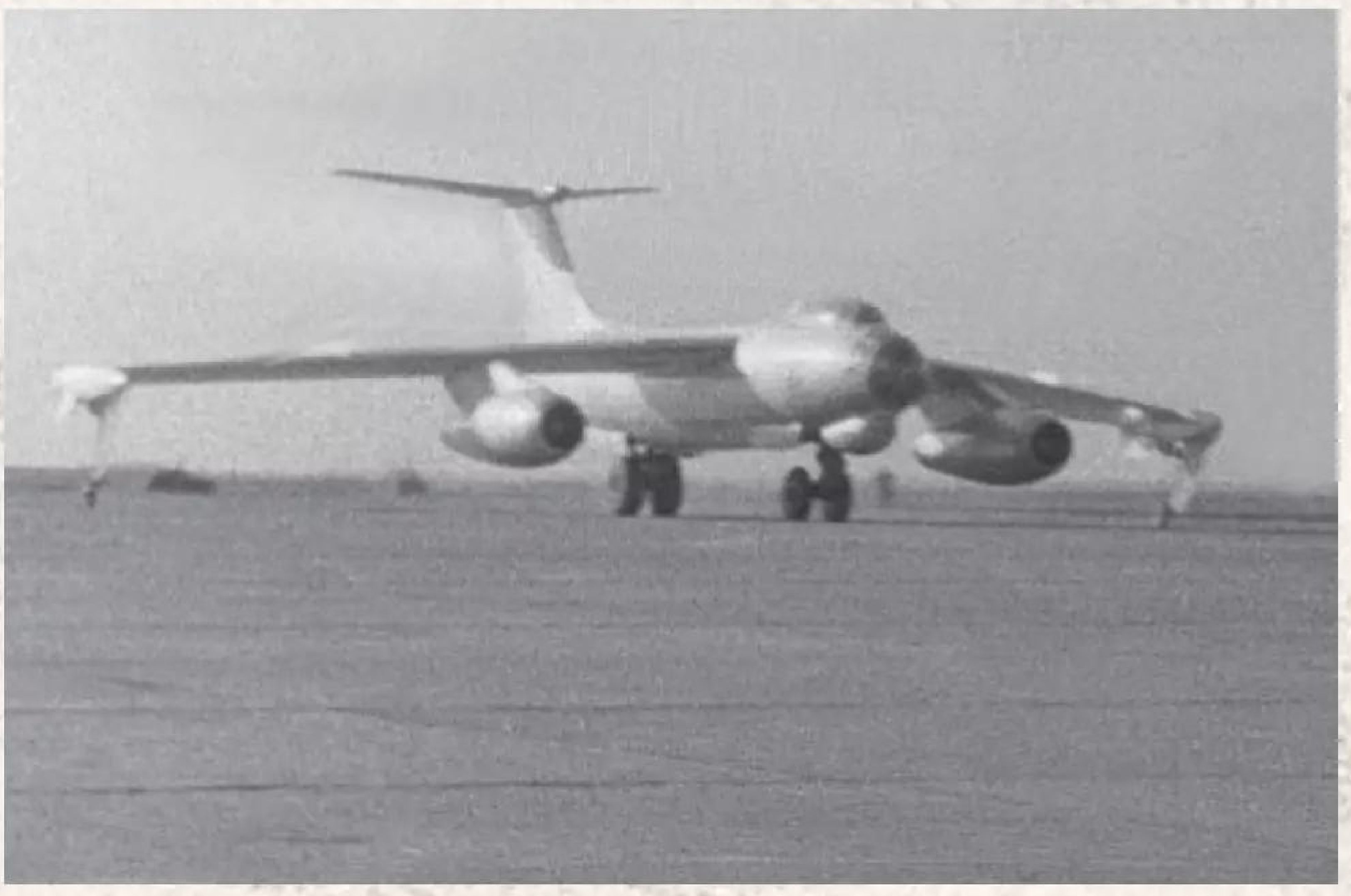
Britain's V-bomber force, the Avro Mk. 2 Vulcan shown here was perceived by Russia as a strategic threat which it sought to match in increasingly hostile times. *(RAF)*

The MiG-17's thin wing with double-sweep angle on the leading edge intrigued Tupolev, who saw aerodynamic efficiency and stiffer wings as crucial for success with long-range bomber concepts. (*Author's collection*)



A further evolution for the German engineers at OKB-1, Type 150 was a swept-wing jet bomber developed from 1948 and first flown on 5 September 1952.

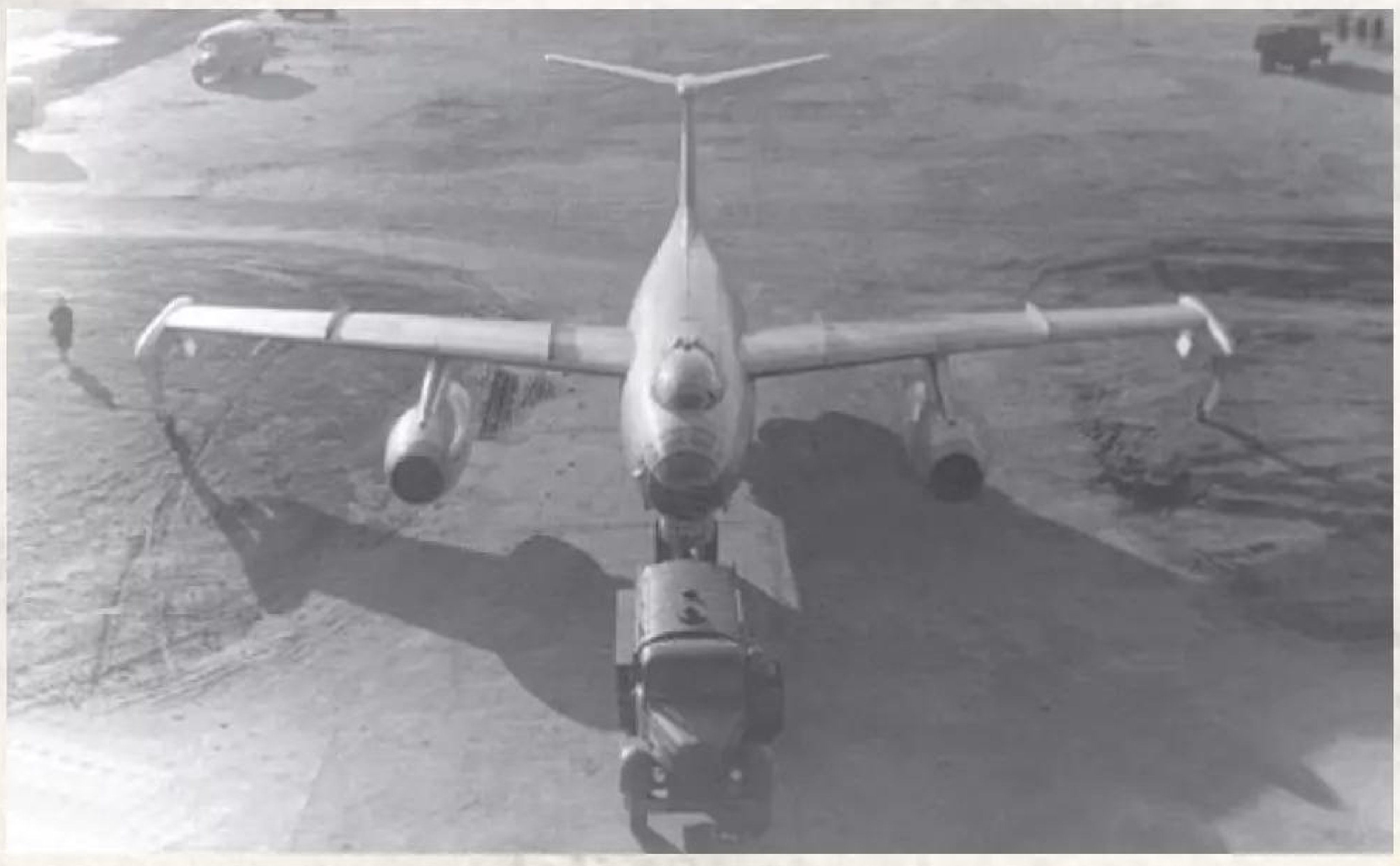
and it found a home with the Russian navy but it was eclipsed in both bomber and reconnaissance roles by the Il-28.

The Tu-82 was a great improvement on the Tu-14, with a reduced crew of three and on 12 June 1948, it was approved by the Council of Ministers and given the official designation Tu-22 (not to be confused with the Tu-22 Blinde*r*). Piloted by A. D. Perelyot, Aircraft 82 made its first flight on 24 March 1949, but a planned appearance at that year's Tushino display was abandoned after an incident of 'recurrent turbulence' during low level flying, tore one of the engines from its nacelle. An emergency landing at Gromov saved the aircraft but emphasised the experimental nature of the programme, nevertheless, providing Tupolev with invaluable experience flying swept-wing aircraft.

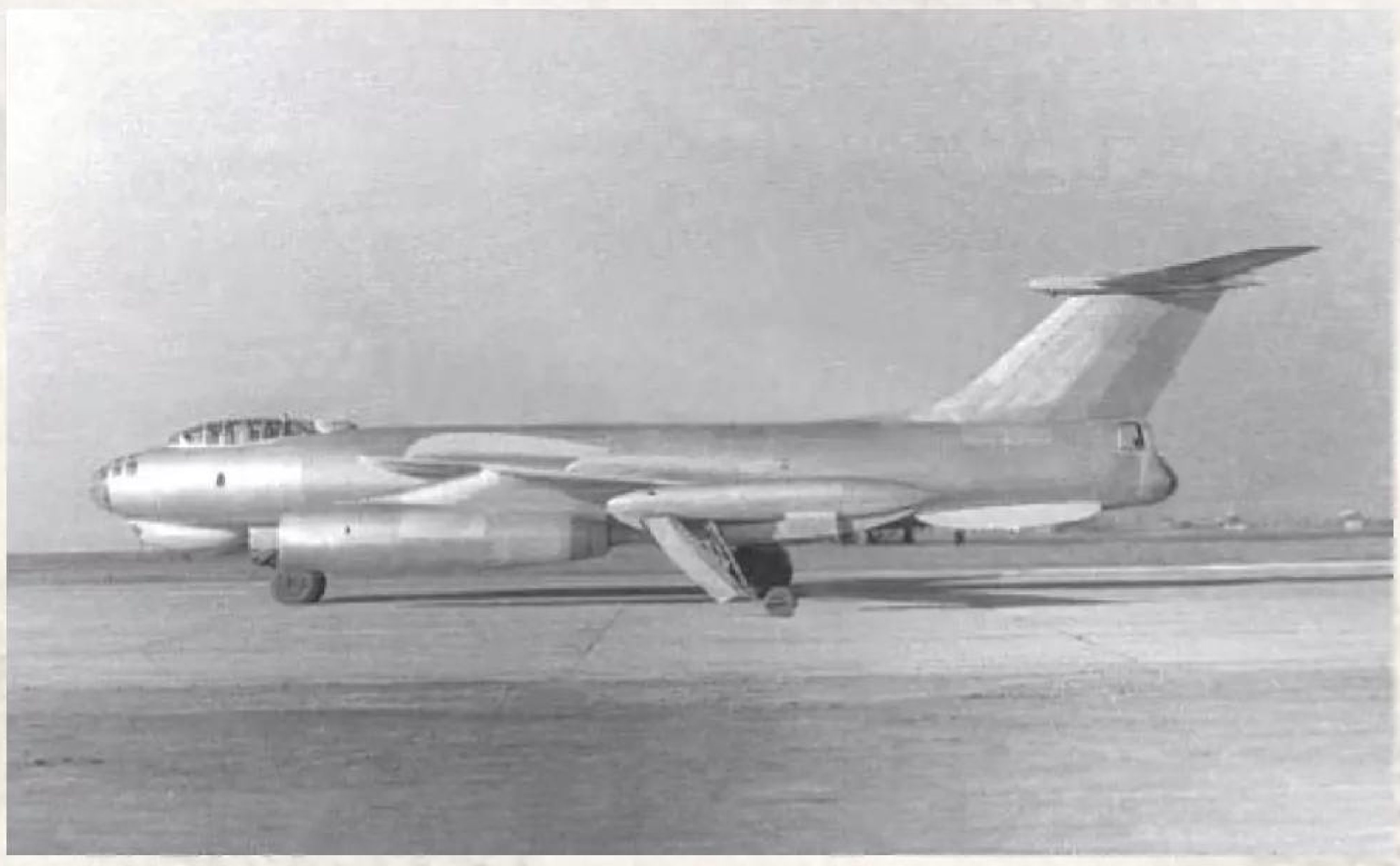
Tupolev was not alone in developing an experimental prototype for swept-wing designs on larger aircraft, Ilyushin achieving the same result with its Il-30. With lessons-learned from Aircraft 82, Aircraft 83 was designed to be a fully operational bomber with a longer fuselage, radar and defensive armament but it was cancelled in 1949. By this time, Tupolev was working on a new generation of designs for more powerful and bigger aircraft in the Project 486 range, denoting the sixth project of 1948, and was followed by Project 491 in 1949. All these spun off from Aircraft 73 but with engines delivering higher thrust levels.

The baseline Aircraft 86 was projected as a long-range bomber with two AM-02 gas turbine engines providing 46,881N (10,540lb) of thrust and a maximum bomb load of 6,000kg (13,230lb) with a crew of six. A continuous series of modifications and redesign features were added but rejection of that design allowed a focus on Aircraft 88, the true progenitor of the Tu-16. This was a derivative evolution of the Project 86 concept but with a wing sweep angle of 35deg and an aspect ratio of 7.9:1. Much of the wing design copied the EF 132. But Tupolev was challenged by the Ilyushin Il-46 and turned the focus at OKB-156 on a competitor with increased performance compared to its opponent.

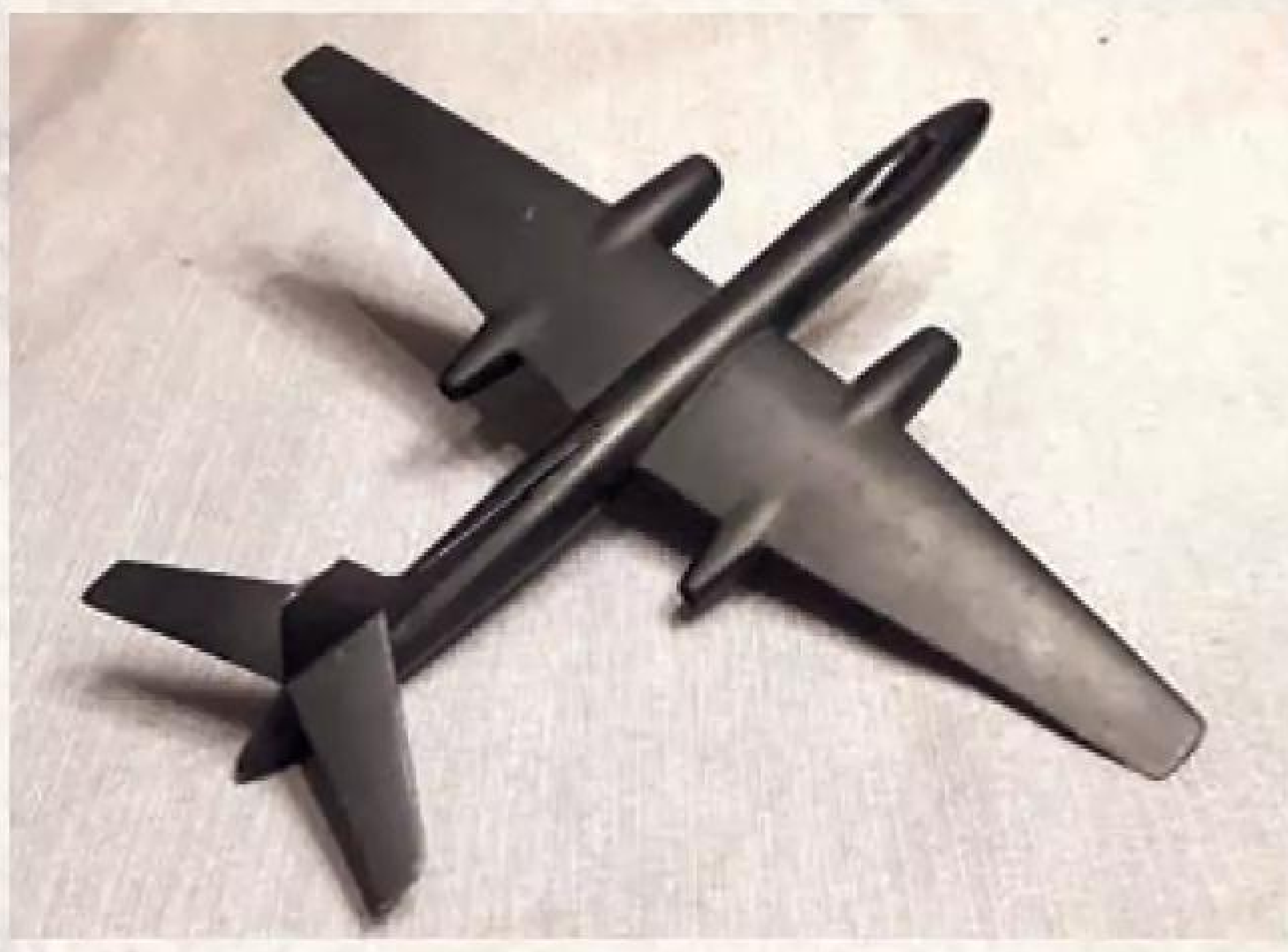
Ilyushin's OKB-240 had been specifically commissioned to design a high-speed



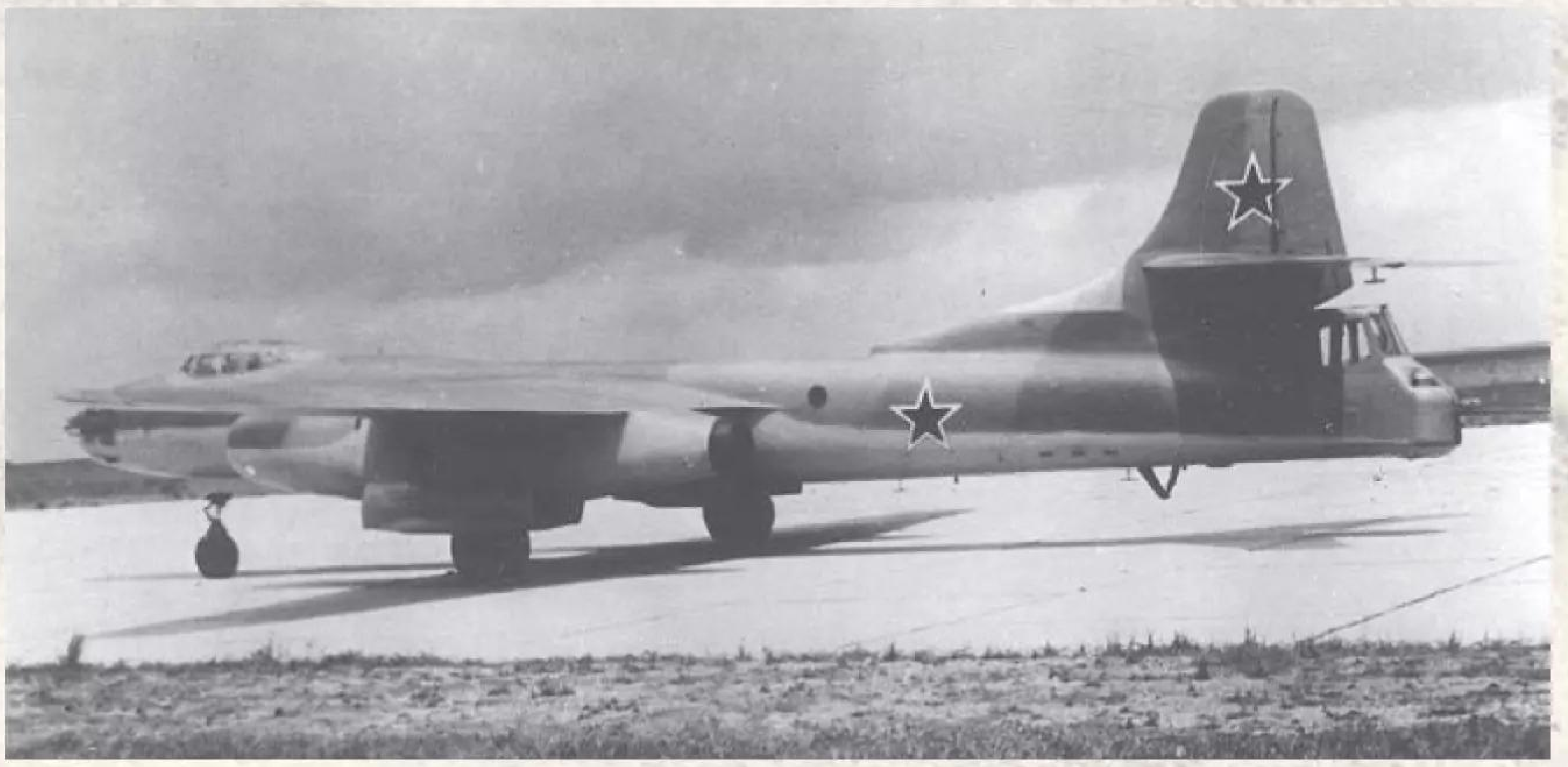
Plagued with numerous problems including a serious weight issue, the Type 150 was never going to become the jet bomber it was designed to be. (*Yefim Gordon via Tony Buttler*)



Type 150 had a tandem landing gear and wingtip wheel assemblies much like the B-52 but on a smaller scale; power was provided by two Lyulka TR-3A turbojet engines. (*Yefim Gordon via Tony Buttler*)

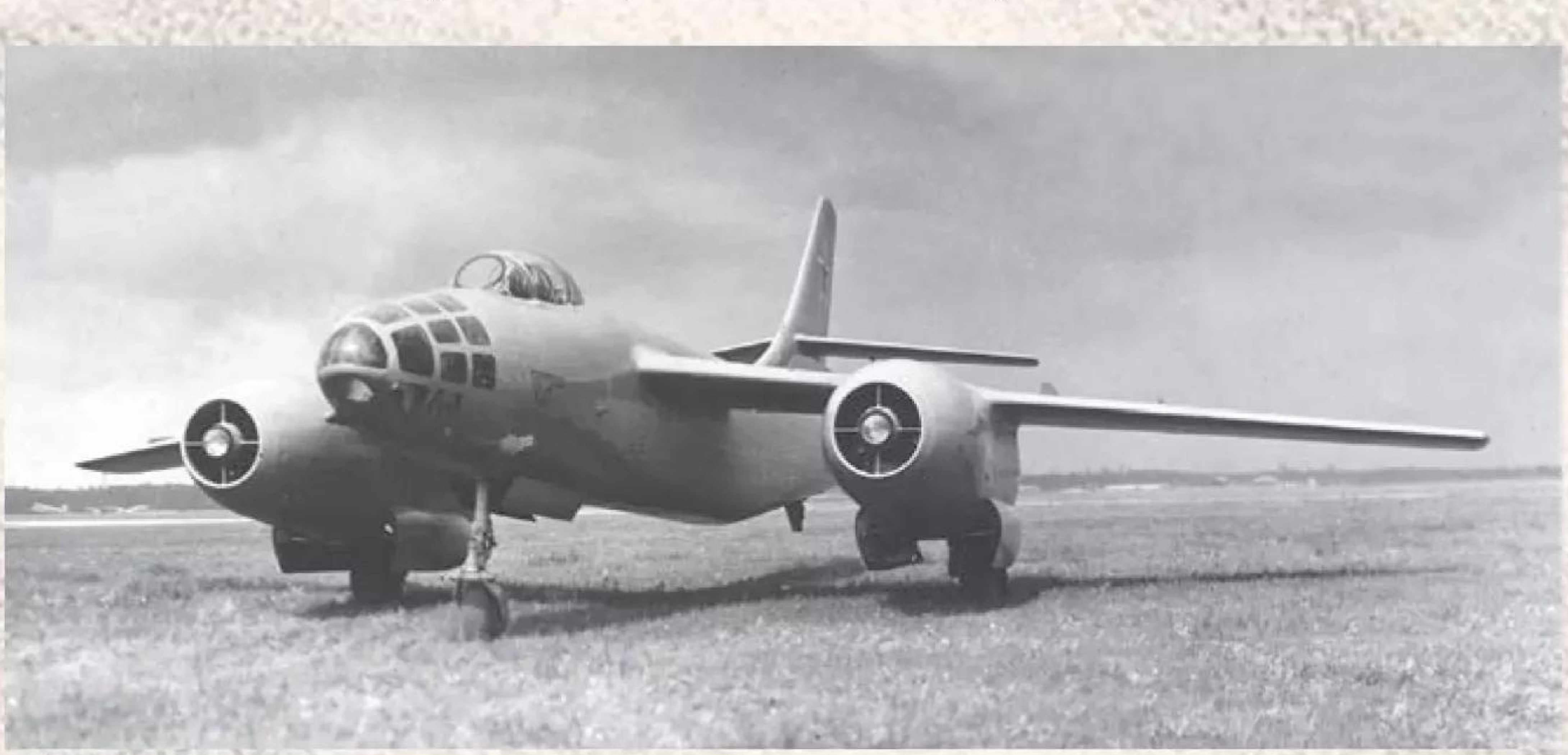


With straight wings and two Klimov VK-1 turbojet engines, the Tu-14 was an evolution of Aircraft 73, as described in the preceding chapter. (*Edwin Borremans*)



First flown on 13 October 1949, the Tu-14 had limited success and only 150 were built before it was retired ten years later. (*Yefim Gordon via Tony Buttler*)

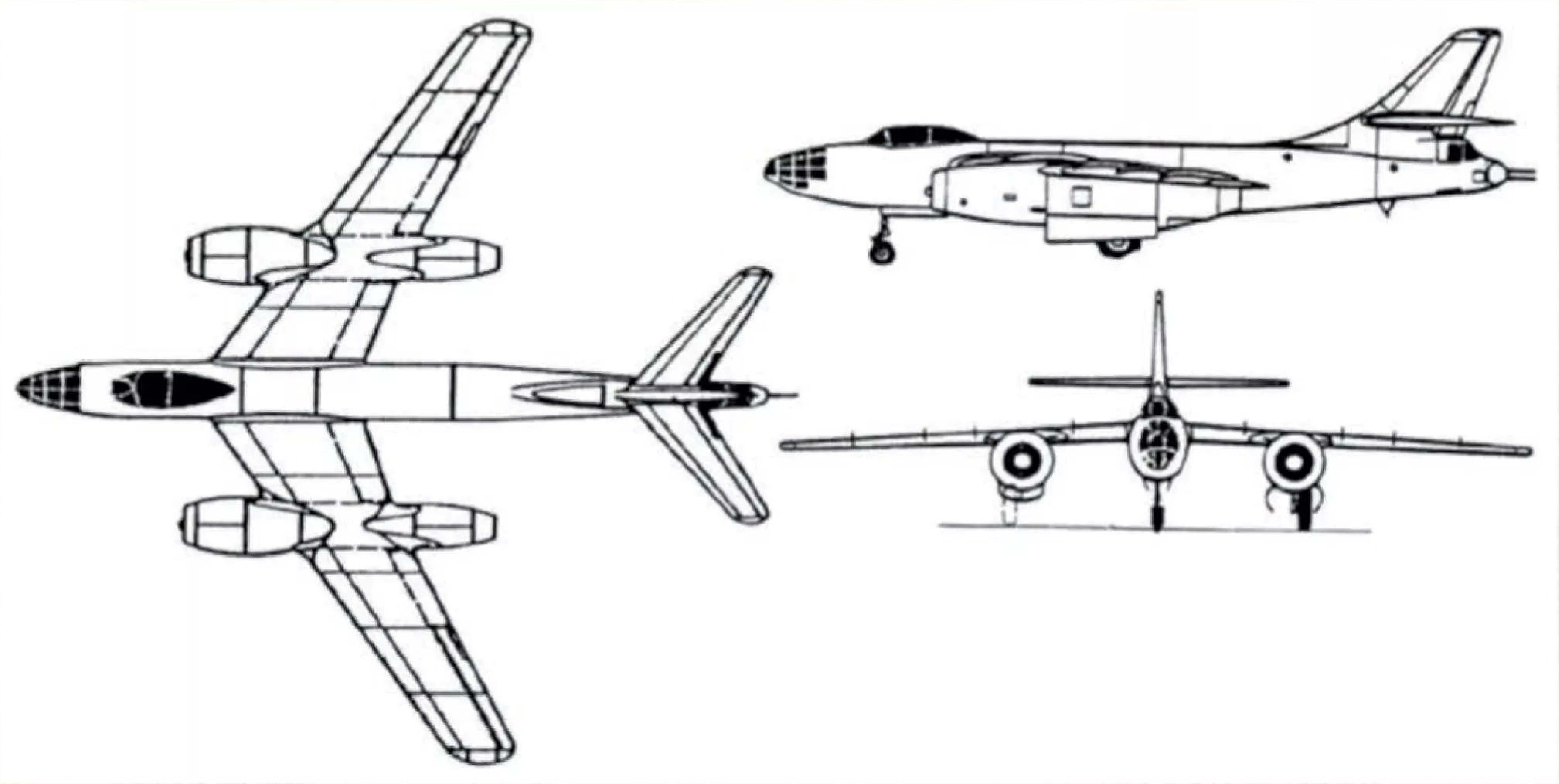
The Tu-14 bore a superficial resemblance to the Il-28 but with the same minimal defensive armament of one tail gun. (*Edwin Borremans*)



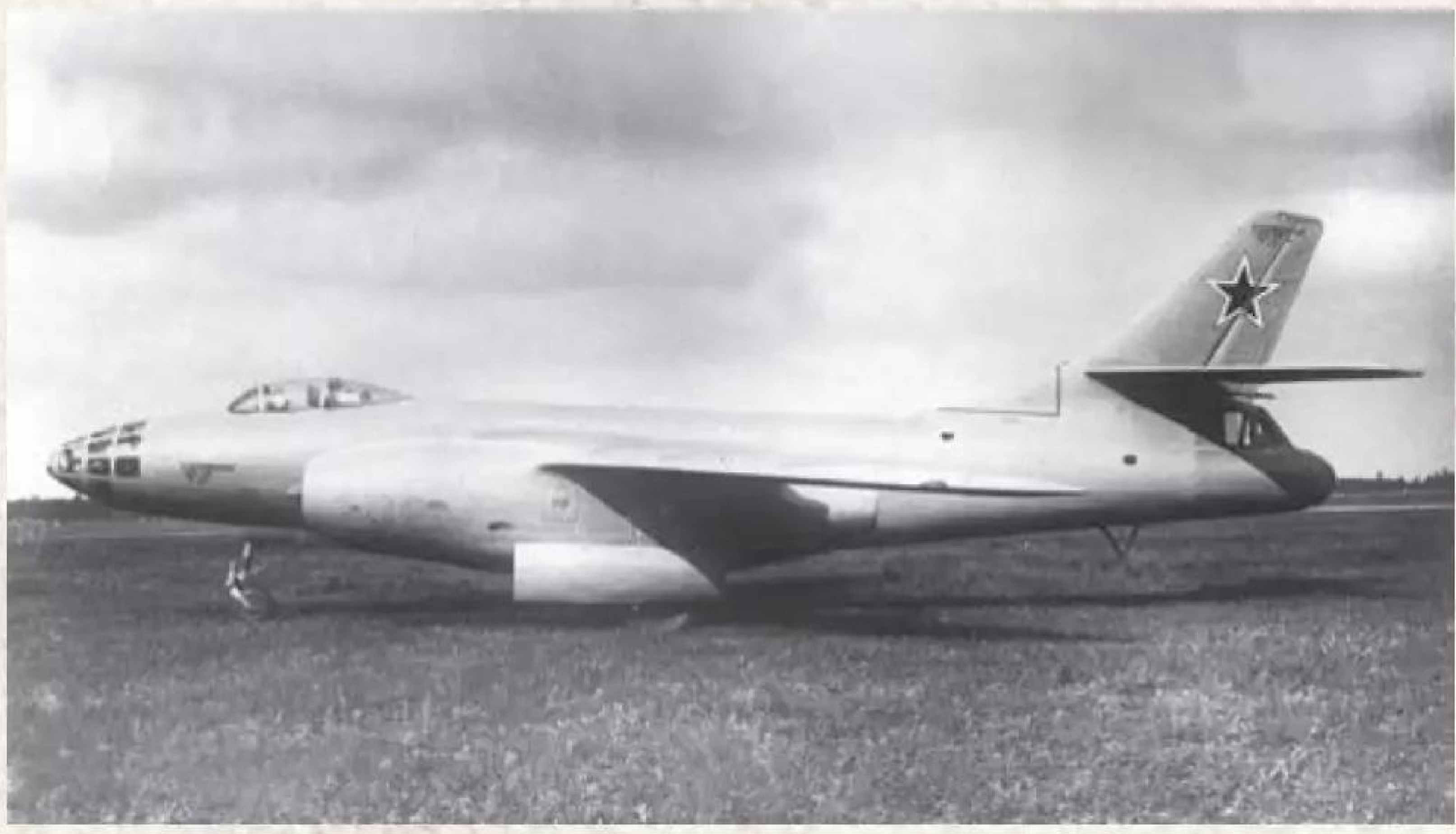
Adapted from the Tu-14, Aircraft 82 (also designated Tu-82 in some literature) was temporarily numbered Tu-22 and made its first flight on 24 March 1949. (*Yefim Gordon via Tony Buttler*)

bomber but Tupolev's Aircraft 88 concept provided confidence that it would have a maximum speed of 1,000kph (621mph) and a range of 7,500km (4,660miles) carrying a 6,000kg (13,230lb) bomb load. Or, it could carry a 12,000kg (26,460lb) bomb load over a much shorter range. The selected engine was Lyulka's TR-3A with a thrust of 49,039N (11,025lb) but provision was made for the AMRDS-03 then under development by Mikulin's OKB-300 with a potential thrust of 80,424N (18,080lb). What ensued, however, was a conflicting mix of various design iterations, each leading to further evolutionary concepts, most of which are irrelevant to the development of the Tu-16.

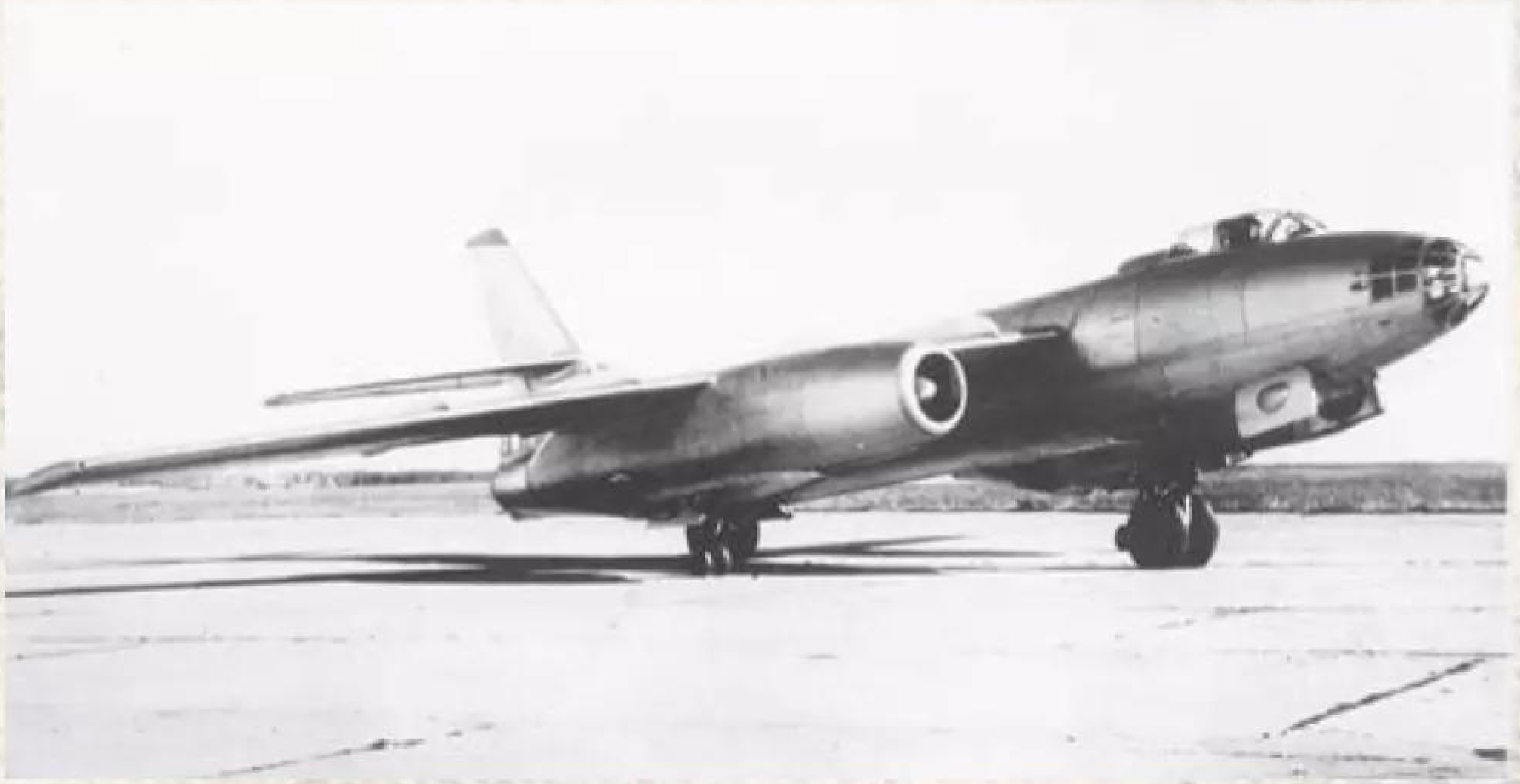
The purest bloodline to what became Russia's first two-engine long-range bomber, which remains in service to this day, was the Aircraft 494 line. Fourth of the concepts approved in 1949 by Tupolev for preliminary design, it came directly from Aircraft 86 through Aircraft 88 and was the responsibility of B. M. Kondorskiy and a specially selected team. It got the very special attention of Andrey Tupolev himself and with the assistance of Babin, Cheryomukhin and Sterlin, the full concept had all its paperwork ready by June 1950. There were three engine types considered appropriate: two AMRD-03, four TR-3A or four TR-5 engines. All had a wing sweep of 35deg. ➤



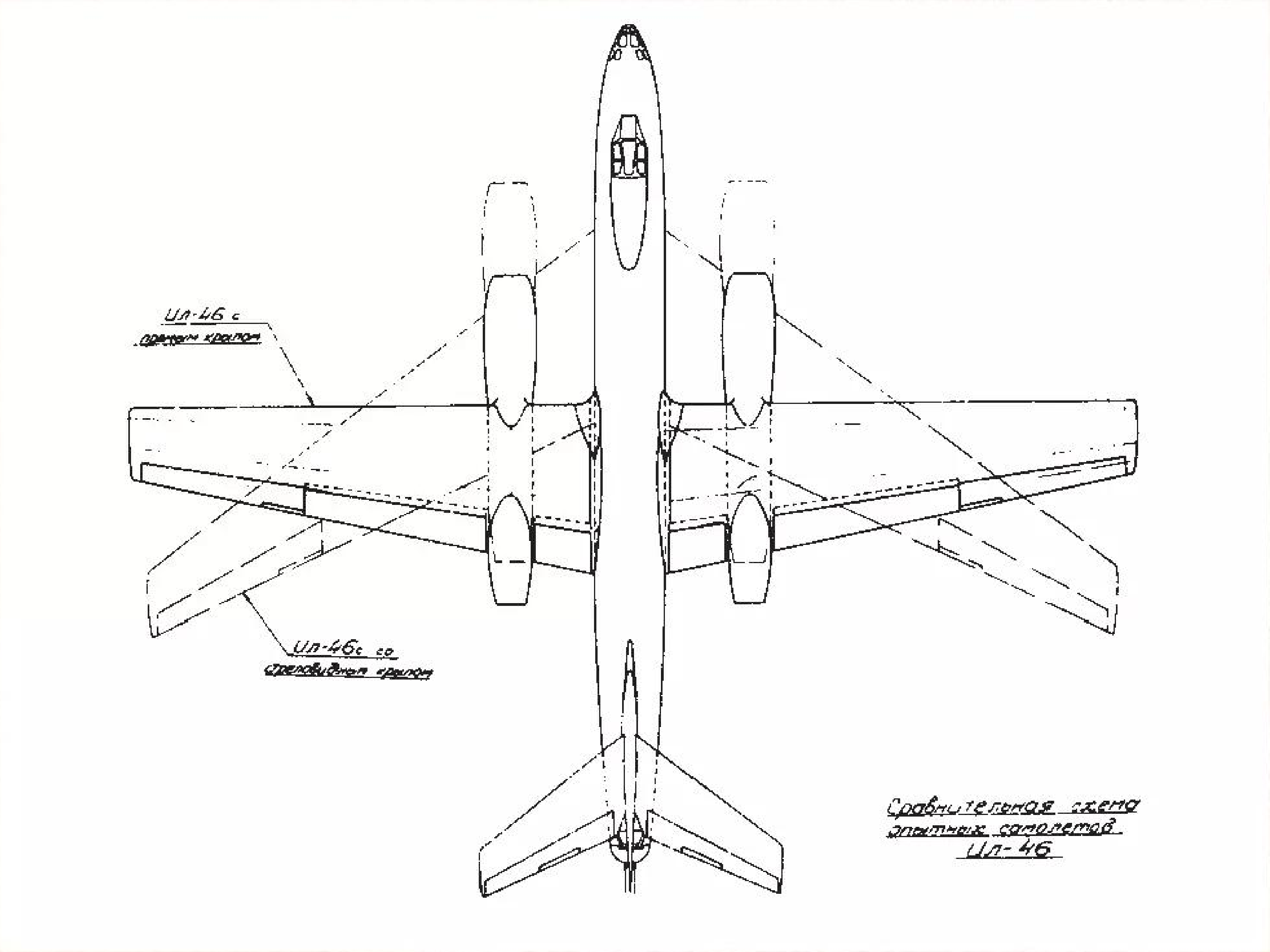
This general arrangement view shows the swept-back design of the Tu-82 developed as a simpler and more efficient twin-engine version of the tri-engined Aircraft 73 concept. (*Yefim Gordon via Tony Buttler*)



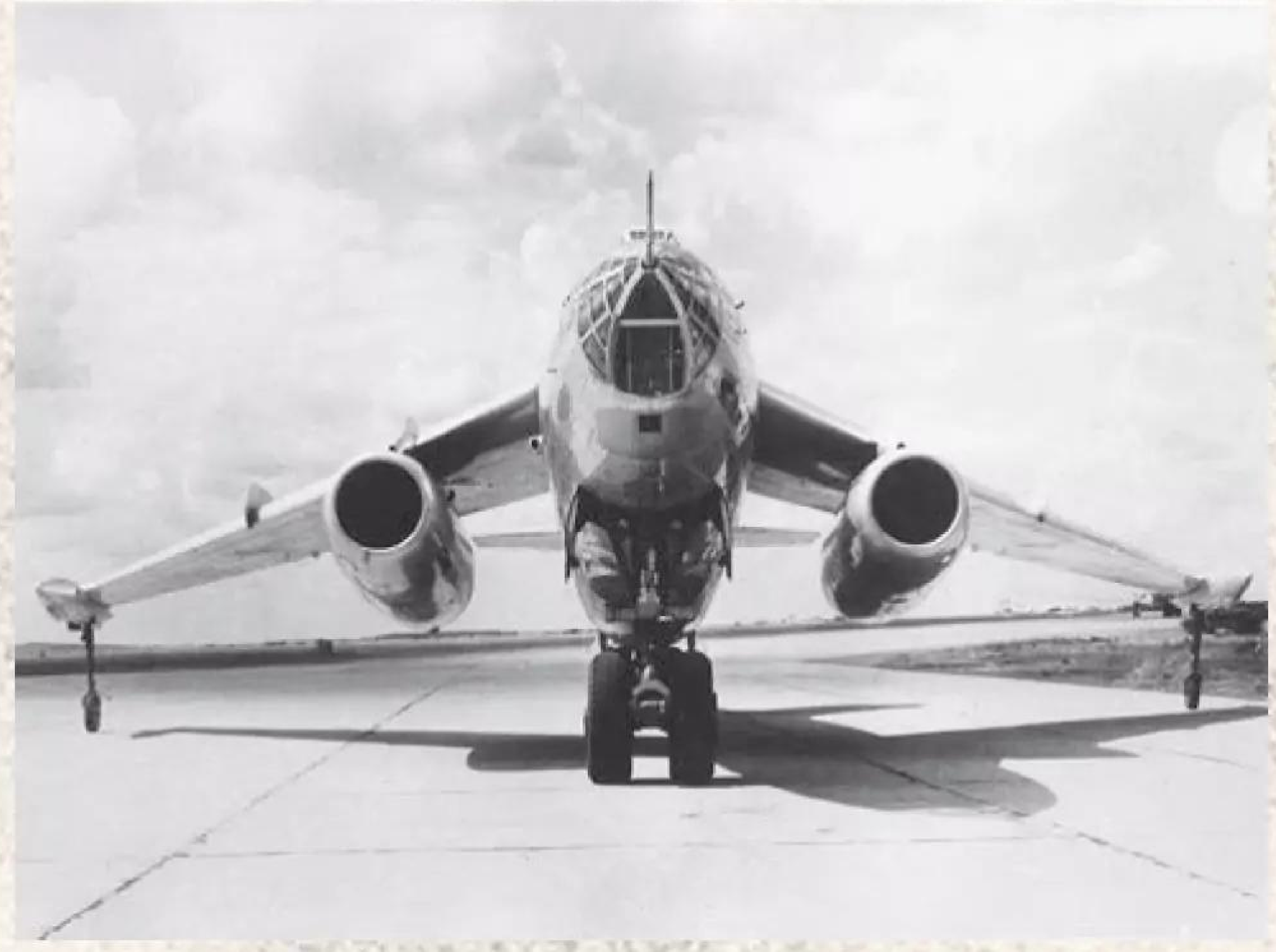
The Tu-82 was a start-point for Aircraft 86, which was larger and designed to be more efficient but which was never taken up. (*Yefim Gordon via Tony Buttler*)



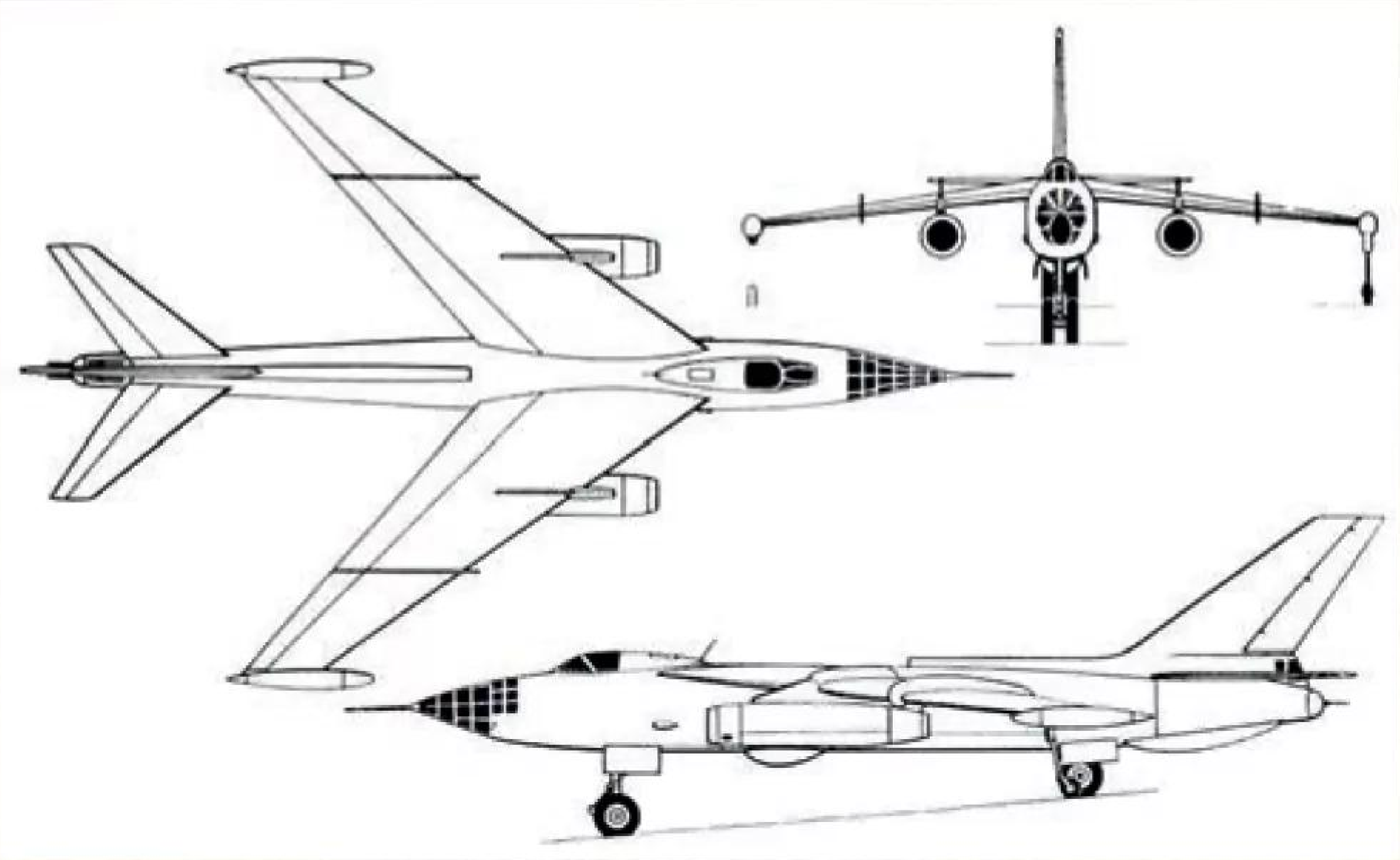
Aiming to produce a transonic successor to the Il-28, the Il-30 was designed to carry a 2,000kg (4,410lb) bomb load but failed to compete against the equally unsuccessful Tupolev Tu-82. (*Yefim Gordon via Tony Buttler*)


Ил-46 с прямым крылом
Ил-46с со стреловидным крылом
Сравнительная схема опытных самолетов Ил-46

In pursuit of a high-altitude, medium-range bomber the Ilyushin Il-46 began life as a straight-wing aircraft and was developed into the Il-46S with swept wings. It never flew. (*Yefim Gordon via Tony Buttler*)

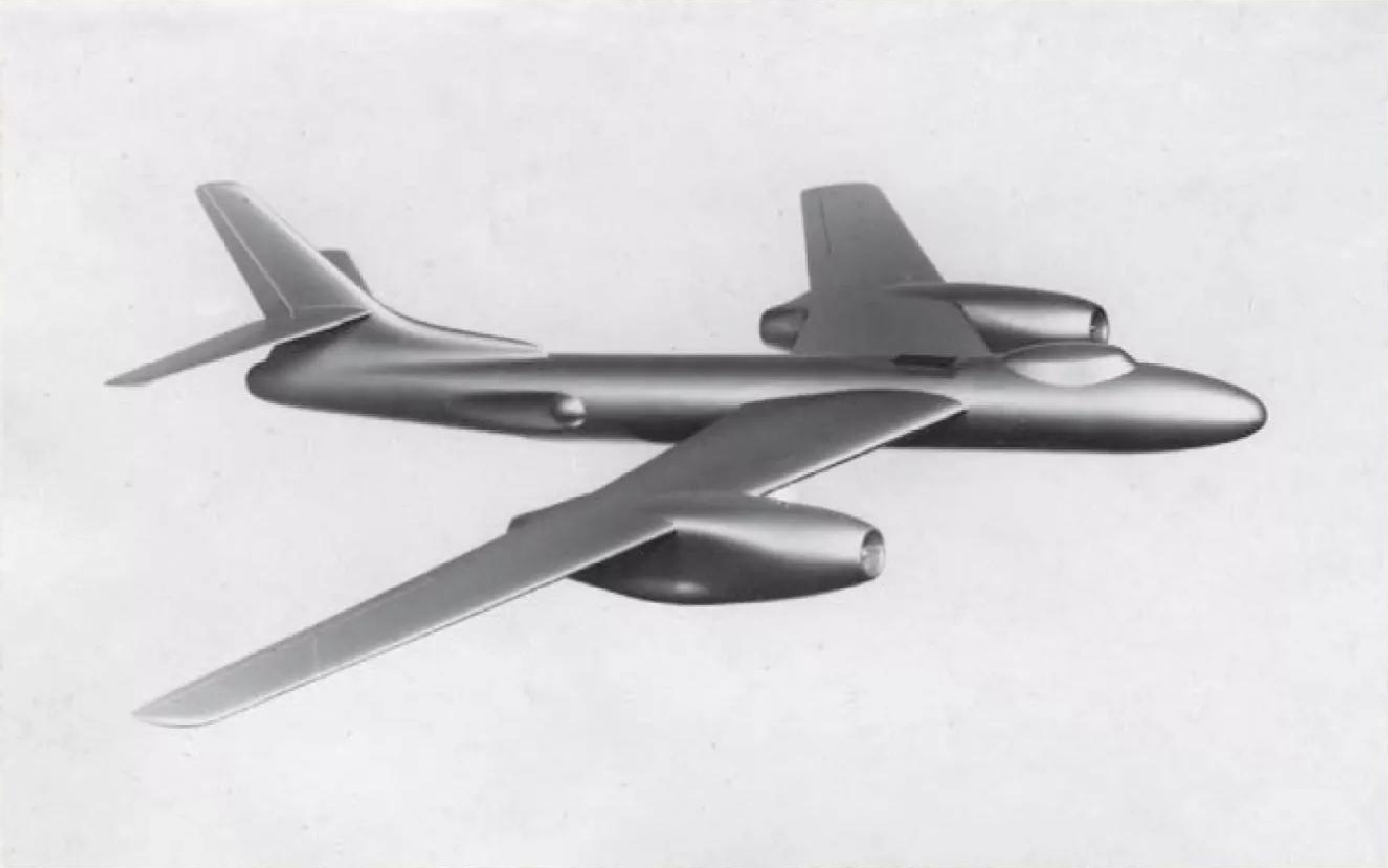


Ilyushin further developed the transonic bomber concept from the Il-46S to the Il-54 which made its first flight in April 1955 but it never entered production. (*Yefim Gordon via Tony Buttler*)

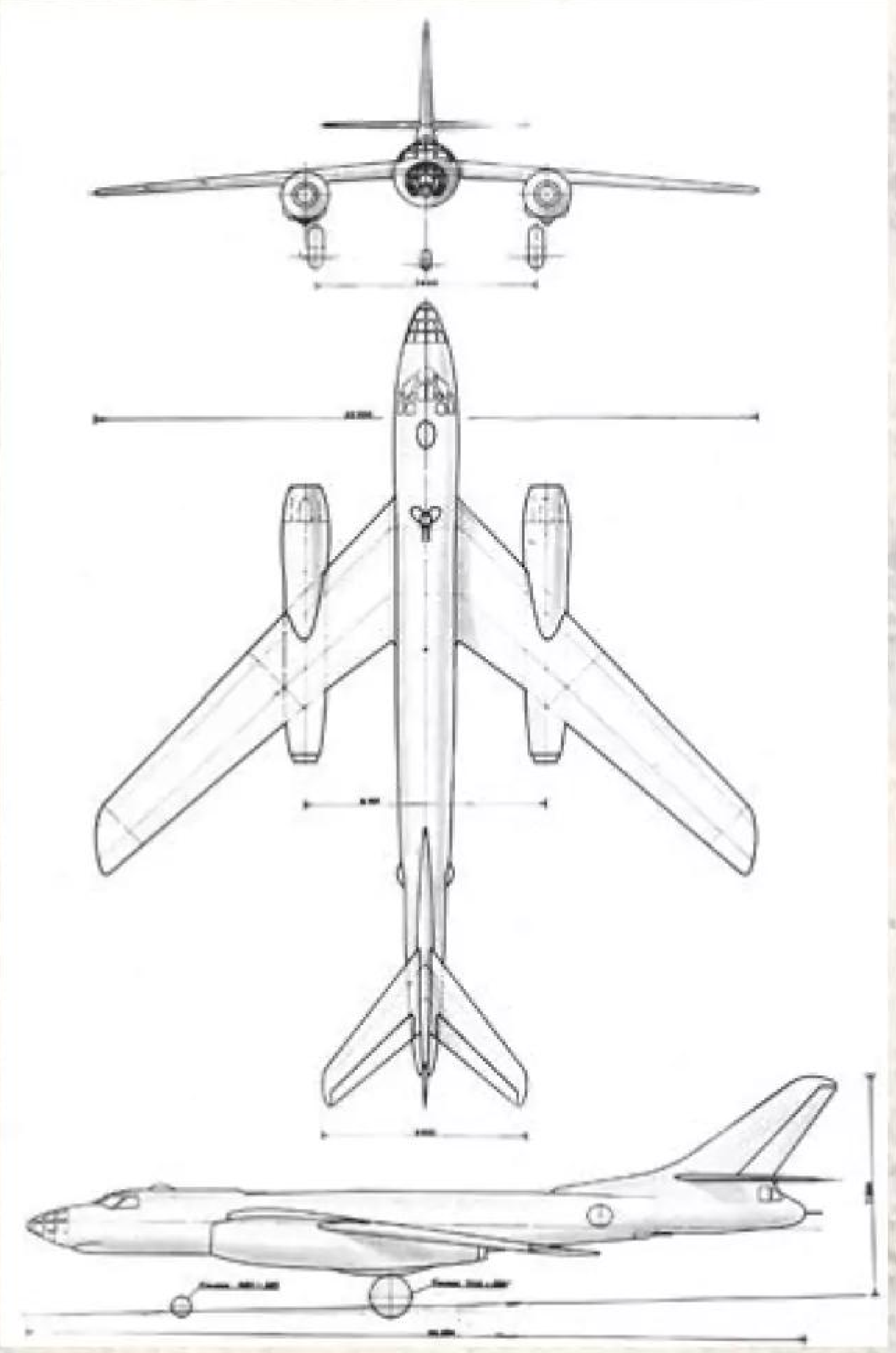


A three-view arrangement drawing of the Il-54, ultimate evolved configuration of the original Il-28. (*Author's collection*)

Aircraft 86 gave Tupolev a further derivation of Aircraft 73 but quickly left that behind in its search for a general design concept for high-speed, long range and medium jet bombers. (*Yefim Gordon via Tony Buttler*)



With swept wings and two turbojet engines, Aircraft 86 morphed from its original, straight-wing design into Aircraft 88, forerunner of the 491 concept. (*Yefim Gordon via Tony Buttler*)



Work began in April 1949 to find a Tu-4 replacement capable of high speed and long range, Tupolev's Aircraft 491 concept having 45-degree swept wings. (*Yefim Gordon via Tony Buttler*)

For the AMRD-03 version there were two options, one (494/1) with engines in fairings at the one-third wing space position with space accommodating the retracted main landing gear and the second (494/2) with podded engines on pylons, the landing gear retracting into wing fairings protruding from the wing trailing edge and positions further out than the pods. Both optional configurations were matched in airframe size, except the weight of the mass attributed to the engines was less for the second version due to the pods. With the AMRD-03, wing area was calculated to be variable in the final design in the range 160-200m^2 (1,722-2,152ft^2).

The configuration for the TR-3A and TR-5 powered versions had three options, one with the same wing area as the 494/1 and 494/2 which would place two of the four engines in the forward fuselage and two on the wings located between the inboard flaps and the ailerons, the main landing gear being retracted into separate wing fairings. The second option was for a wing area greater than the 494/1 and 494/2 versions. This had a range of alternative engine positions yet to be finalised. From all four on the sides of the aft fuselage or two on the fuselage and two on the wingtips, or all four mounted on wing pylons. In each case the landing gear would retract into dedicated fairings.

The third option envisaged a wing area of 200m^2 (2,152ft^2) with the four engines mounted one above the other in pairs either side of the fuselage in wing fairings with the main legs retracting forward into them. Weight increased incrementally across all three options and could be selected along with the engine types depending on availability. After analysis of all these options, Tupolev opted to recommend a version with two TR-3A engines mounted side-by-side within inboard wing fairings.

But that was far from the end of the story. Further iterations were applied to the overall configuration, launching Project 495. This used the AL-5 engine, one buried in each inboard wing section and faired over, the wing having an area of 140m^2 (1,507ft^2) with wind tunnel tests showing very positive results. But there was a contested debate over the position of the engines, pylons preferred by Tupolev with landing gear retracting into wing fairings while TsAGI doubted the structural value of that configuration.

Strangely, underwing pylons so readily adopted for a range of military and commercial aircraft in the United States were treated with reticence in Russia. TsAGI had acquiesced to Baade's 150 project with its podded engines but only with reluctance. And again the debate opened up once

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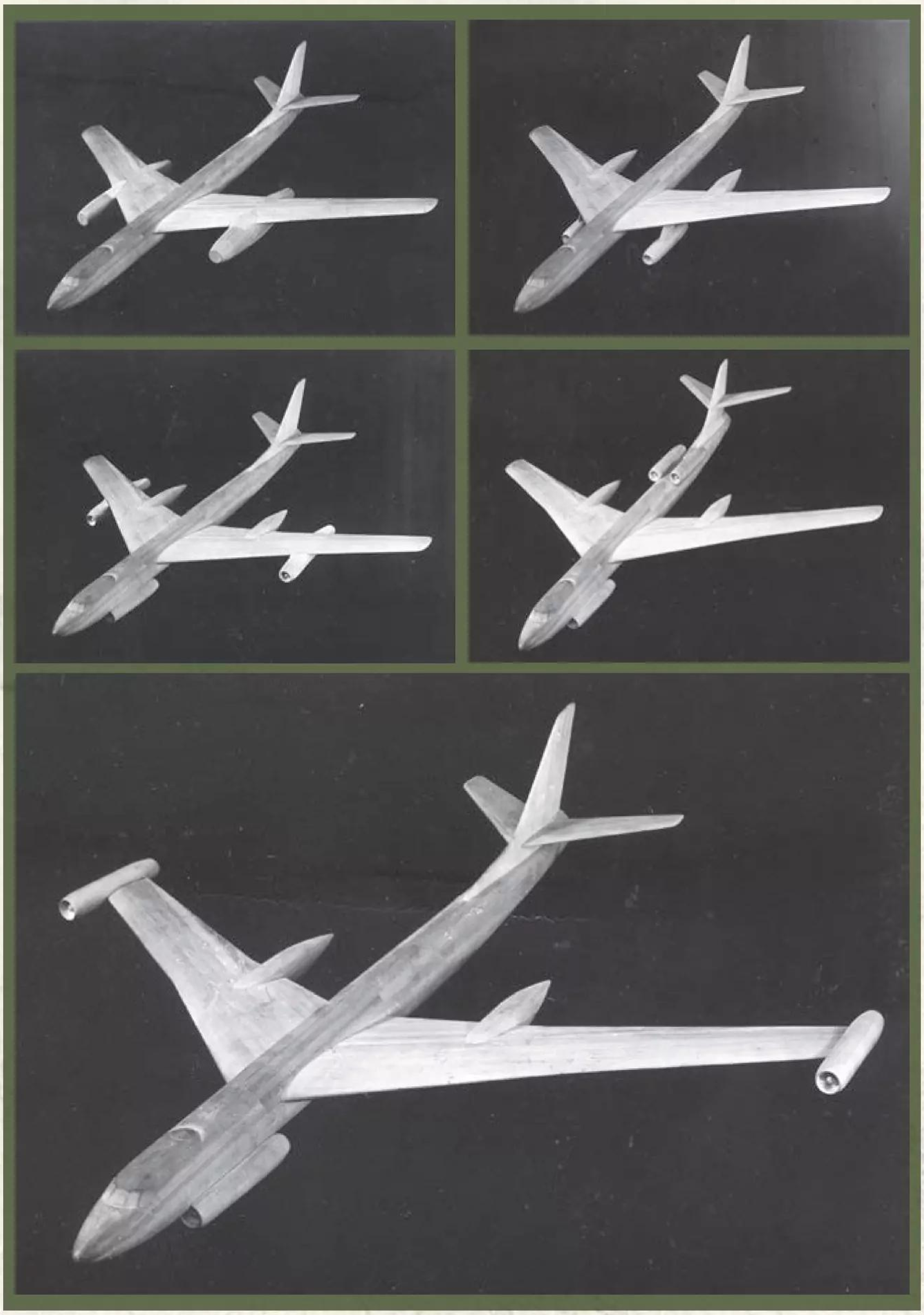


Tupolev's Aircraft 494 project included a wide range of configurations and engine locations, shown here in a selection of wind tunnel models. (*Yefim Gordon via Tony Buttler*)

more on the type of engine to adopt, options now embracing two AMRD-03 engines, four TR-3A engines or four TR-5 engines, all with or without afterburning.

From all of these studied permutations, three primary options were established which appear to have been the deciding criteria for further selection of the overall configuration. There was a determination that engine power was crucial for achieving the required performance, that constraints on the options for a twin-engine configuration were wider than for a four-engine layout and that the take-off weight should be within the range 60,000-100,000kg (132,300-220,500lb). It was also determined that the wing area should be 150-250m^2 (1,614-2,691ft^2) and that the thrust available should be more than 117,694-137,310N (26,460-30,870lb).

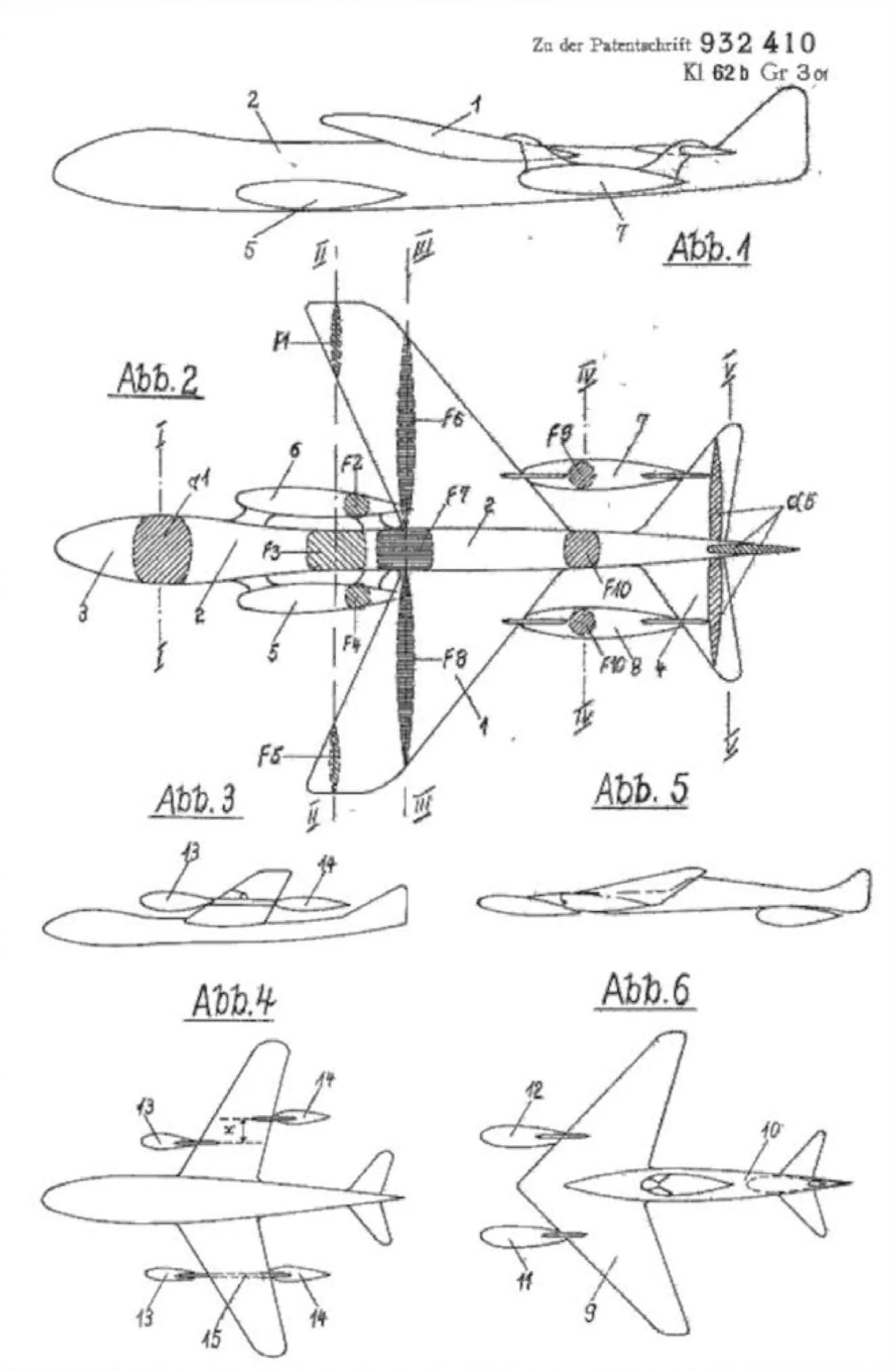
By integrating critical elements in power and performance, these criteria defined the choices to shape the final configuration and layout. The analyses outlined here formed the agenda for a conference at Tupolev on the evolution of Aircraft 494, Babin and Cheryomukhin outlining the various options and Tupolev presenting his own preferences. The definitive conclusion was that OKB-156 should base its design proposal on Aircraft 88, which already showed a higher performance margin over the competitive Il-54. But even at this stage, the Tupolev designs appeared to be on a more secure course than any of the competing concepts from other OKBs and the persuasive powers of Tupolev brought it home.

On 14 June 1950, the Soviet Council of Ministers issued a directive for Tupolev to deliver a long-range jet bomber powered by two TR-3F engines, which had previously been designated TR-3A. This engine would subsequently become the AL-5, with a thrust of 49,039N (11,025lb) and adopting the refined criteria on which the Council had been briefed and which formed the basis for the order. There were to be two prototypes and the Council wanted the acceptance trials to be held no later than December 1951. Work on the Tu-88 raised great doubt on that schedule and it was extended by three months. As work progressed and the detailed design intensified it became apparent that the selected engines were not sufficiently powerful and a switch was made to the AMRD-03, known as the AM-3 in production.

In February 1951, Tupolev decided to gamble that this engine would be available, although the commitment would not be finalised until the first engine of that type had been tested. With government pressure to get the AM-3 into production, the MAP issued an order on 30 August that Aircraft 88 was indeed to be powered by this engine, which promised a thrust of 85,328N (19,180lb). To help speed development, a Tu-4 was assigned as an in-flight test bed for the AM-3 to support delivery of the first prototype Aircraft 88 in November 1951.

Development of this engine began in 1949 at Mikulin's OKB-300 and it emerged successfully through a series of tests before production got under way in 1952. This engine represented the first major engine development in post-war Russia, built only marginally on previous experience with the British and German engines. It would be the mainstay for Soviet combat aircraft and for an expanding range of civilian types. The design was based around an eight-stage compressor and a two-stage turbine with an annular combustion chamber and a fixed-area nozzle. It had a self-starter and a built-in de-icing capability with a heat exchanger for oil cooling which tapped off the main fuel supply bleed.

Before the Soviet directive of June 1950, authorising prototype production, the Council of Ministers issued a formal requirement to match the Aircraft 88 proposal, updated on 11 September to formalise use of the AM-3. A series of



Russian aircraft manufacturers applied the area-rule concept to the design of fast jets, a formula first identified by German engineer Otto Frenzl in a patent (shown here) at the Junkers works in 1943 and taken by the Americans to the USA in 1945 where it was refined by Wallace Hayes two years later. (*Author's collection*)

The seminal exponent of area-rule in the US was Richard Whitcomb, posing here beside a wind tunnel model of a 'coke-bottle' fuselage. Details of his work were meticulously documented and sent to the USSR by Russian spies. (*NASA*)

A successful combination of aerodynamically efficient swept wing and credible performance, the Tu-16 was Russia's first jet-powered strategic bomber with conventional or nuclear capability. (*Author's collection*)

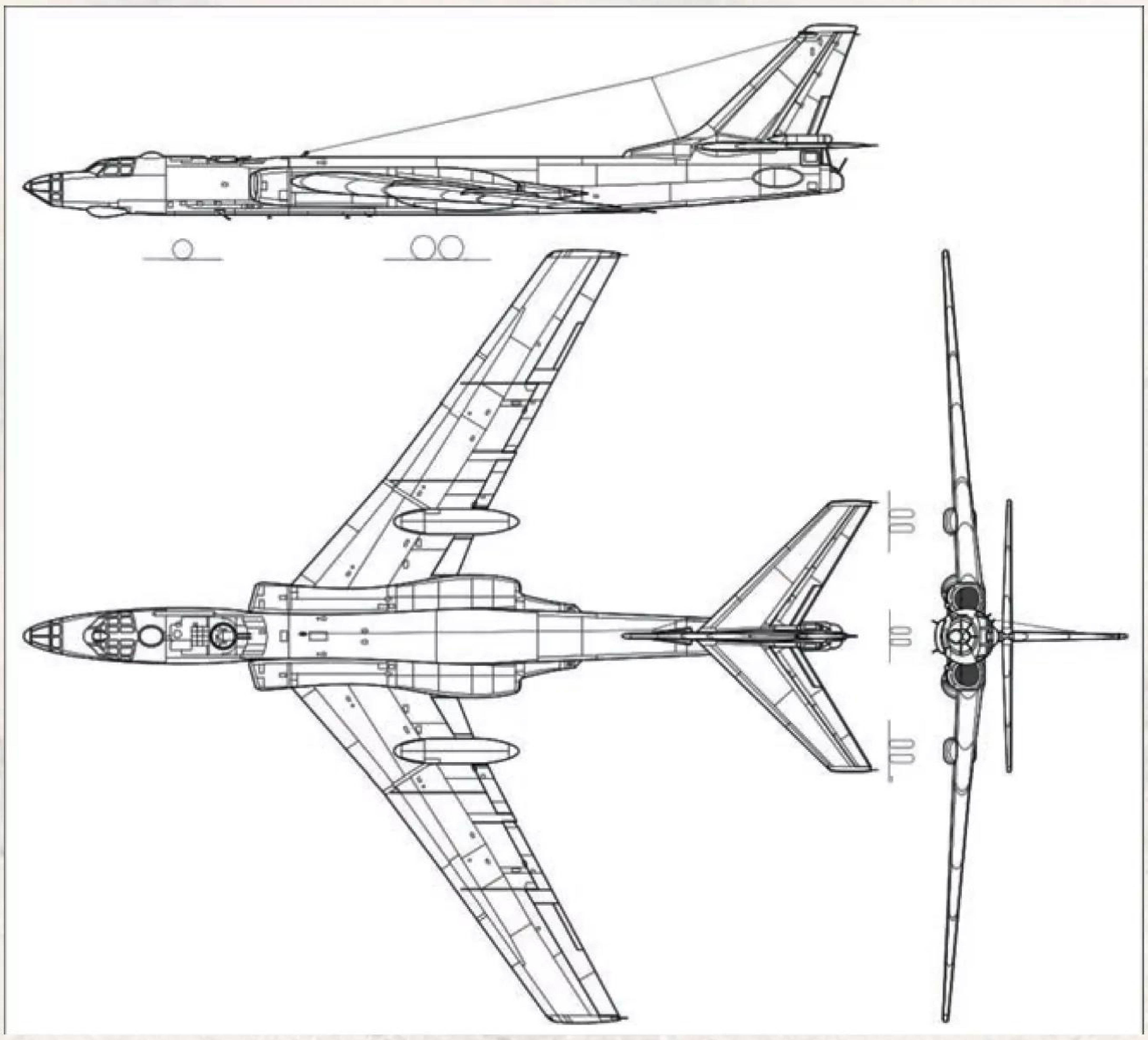
evaluations ensued and after design work had been completed on 20 April 1951, the Aviation Technical Committee confirmed its satisfaction with the type on 29 May. The mock-up was already well underway by this date and it was completed by 20 April 1951, but a protracted series of contested changes held the programme back for some time, the Aircraft 88 configuration being considerably different to previous briefings and mock-up inspections.

AREA-RULE

Much about the design of the Tu-16 was the product of extensive research and development at TsAGI and Tupolev where emphasis was placed on aerodynamic performance and on the latest wind tunnel and flight results from tests close to the transonic region. The result was a more extensive range of technical features than had been seen on previous projects. The application of these advanced design innovations played into the delays caused by uncertainties and disagreement over aspects of the aerodynamic shape which were new to several inspectors.

The prime shift in design philosophy was the application of transonic area-rule. Outside Russia, the originator of that mathematical model is mostly credited to Richard T. Whitcomb as applied in the United States in 1952, although fellow-American Wallace D. Hayes had developed it five years earlier. But the principle had been set down by Otto Frenzl during work at a Junkers wind tunnel in 1943. Frenzl noted that the same wave drag is maintained through a range of different cross-sectional changes quite independent of the total included area, such that a transitional narrowing of the fuselage at the wing juncture ensures minimal added drag.

Other experimental engineers included Dietrich Küchemann who was already working to this concept. These results were liberated by the Americans shortly after the war. But the initial application of area-rule was with a range of concepts from ➤



A three-view drawing of the Tu-16 with its sleek profile, pronounced 'area-rule' and teardrop main gear housings on the inboard wing sections. (*Kaboldy*)

Junkers in 1944 and through a wide range of designs from Messerschmitt and Focke-Wulf. Henschel also applied the area-rule principle with the Henschel P.135. The area-rule concept had been used by Junkers with location of the engines on the Ju-287 so that the overall cross-section would benefit from this principle.

Tupolev applied only a moderate touch of area-rule, principally with the dynamic arrangement of the engine fairings and with the integration of the interface between the wings and the fuselage and between the air intakes, the engines and the fairings for the landing gear. The Aircraft 88 design had shifted the focus toward the new aerodynamic rule book and Tupolev is rarely given credit for introducing these trends to the Soviet aircraft industry, with significant assistance from TsAGI.

Everything about the Aircraft 88 design was built for high subsonic speed, range and aerodynamic performance. The latter aspect is visibly apparent from the blending of the engine fairing over the inboard wing sections and the recognisable 'coke-bottle' shape in planform. The single air intake for each engine was bifurcated to channel one flow of air through the wing torsion box and another below.

Engineers working the design emphasise the priority given to the arrangement of the wing/fuselage juncture and the engines so that the jet efflux sucked away air flowing around that part of the airframe, smoothing out the flow over and below the interface. The rear fillet between the wings and the fuselage was a critical part of achieving that. This was one other reason too why the engines were buried deep in the wing and close to the root.

So successful was the process of smoothing and integrating the aerodynamic flow patterns that TsAGI was hard pressed to understand how the drag had been reduced substantially compared to previous designs. Everything was done to prioritise speed, including giving the vertical tail a greater sweepback so that shock-stall occurred later than that for the wing. With an aspect ratio of 7:1 in the final wing design the basic torsion box was formed by webs from the two spars and the upper and lower wing panels and this was a significant departure from conventional practice in the West.

Boeing led the field on large, swept-wing aircraft for military and commercial markets, followed by Douglas, Convair and Lockheed. But there, wing design was very different. Designed with flexible wings to dampen out vertical gusts through substantial deformation, they incurred high stress and fatigue levels which would present consistent problems operationally and in service life. It was a practice that became embedded in aircraft designed for high subsonic speeds for the next 50 years and more. The Tupolev wing was designed to a more rigid specification and would endure greater stress without the repeated fatigue and repair problems encountered by American aircraft.

With the NATO code name Badger, the Tu-16 was developed into many variants, including this reconnaissance model (Tu-16R) showing tail armament. (*Author's collection*)

A navalised Tu-16K10 adapted to carry cruise missiles. (*DOD*)

Egypt received 30 Tu-16 variants mostly for cruise missile or anti-radar use with weapons also provided by Russia. Two are seen here during the 1980 exercise Operation Bright Star. (*DOD*)

Flexible wings require more exotic and expensive materials whereas stiff wings require greater strength, which brings a weight penalty. Of all the American manufacturers, Lockheed alone produced stiff wings and that had a penalty in cracked spars due largely to insufficient strength. Before the use of composite materials, structural stiffness came at a cost and the ride was noticeably different with flexible wings smoothing turbulence as energy was absorbed and dissipated through vertical motion, and sometimes axial rotation, of the wing.

The tricycle landing gear of Aircraft 88 allowed designers to provide a large bomb bay behind the rear spar and that accommodated a wide range of bomb options. Located close to the centre of gravity, the bay was outside the main load-bearing structure and the rigidity of the fuselage was ensured through strong longitudinal beams. Overall, the design of the fuselage ensured a tough and forgiving structure, typical of many Russian aircraft of the period. By comparison, American and to some extent British post-war aircraft designs opted for a balanced approach shaping both materials and engineering around a mixed concept.

Two pressurised sections accommodated the crew, with two rear gunners now included in the aft compartment to share the tail-gun responsibilities. Aircraft 88 now incorporated three remote-control turrets each with two cannons, and a fixed, forward-firing cannon on the starboard side of the nose. The arrangement of the defensive armament was superior to other aircraft of the period, with optional Topaz or Argon ranging radar.

The landing gear arrangement now included twin wheels on the forward strut to reduce vibration, shimmying and lateral oscillations, making this the first Russian aircraft to incorporate this feature. Reminiscent of the Vickers Valiant B.2 but developed without reference to that British bomber, the main gear still retracted backwards and the tail incorporated a braking parachute.

In the interests of achieving early operational deployment and availability as the first Russian bomber required from the outset to be nuclear capable, the ➤

An F-16A of the Royal Norwegian Air Force ‘escorts’ a Tu-16 away from national airspace. (*Author’s collection*)

The Myasishchev M-4 was an advanced strategic bomber employing a range of materials and manufacturing processes new to the Russian aircraft industry. (*Yefim Gordon via Tony Buttler*)

overall design philosophy urged the use of existing and proven materials and processes. The schedule moved quickly, a full set pf blueprints following construction of the prototype between February 1951 and January 1952, with a plan to move it to the flight test centre at the Gromov airfield near Zhukovsky, where it arrived on 25 January 1952. Meanwhile, a static test article was prepared and delivered to TsAGI with most of that year spent determining the structural strength of the aircraft.

Taxi tests began on 24 April 1952, with the first flight taking place three days later in which N. S. Rybko took the prototype into the air for 12 minutes. In all, 46 flights were made by 29 October accumulating 72hr 12min during which the prototype demonstrated a maximum speed of 1,020kph (634mph), higher than the specified requirement. But even without all equipment fitted, the aircraft was heavier than planned, coming in with a take-off weight of 77,350kg (170,556lb) versus the projected 64,000kg (141,120lb). Despite this it was submitted for acceptance trials which began on 13 November 1952.

The overweight condition was accepted for state trials but a serious weight-reduction programme began for the second prototype.

The reason exposes a reality prevalent in Soviet machine industries of the time, when, in the final years of his life, Stalin was returning to an excessive paranoia over malpractice, deception against the state and a suspicion that managers and bosses were siphoning off government funds for personal gain. This brought a concern over the consequences of failure and an over-cautious approach to risk mitigation. Anecdotal evidence supports the claim by many that they feared for their lives if a major defence project failed, or embarrassed the Soviet leadership. Because of this, the first prototype had been given additional margins of safety which increased the weight.

Weight reduction on the second prototype was already underway before the first prototype had been finished and work focused on lightening non-stressed structural assemblies, redesigning joints and fasteners in the stressed components and changing materials. Moreover, a limitation on speed up to an altitude of 6,250m (20,500ft) reduced the maximum aerodynamic pressure and stress on the structure. Notes and calculations from test engineers indicate that the overweight first prototype would at least fly and do that well, sufficient to allay any focus on political oversight from the ideological watchdogs reporting to the Kremlin. It must be remembered that even at this date, because of their unique specialities some engineers were still being released from gulags to work on defence projects.

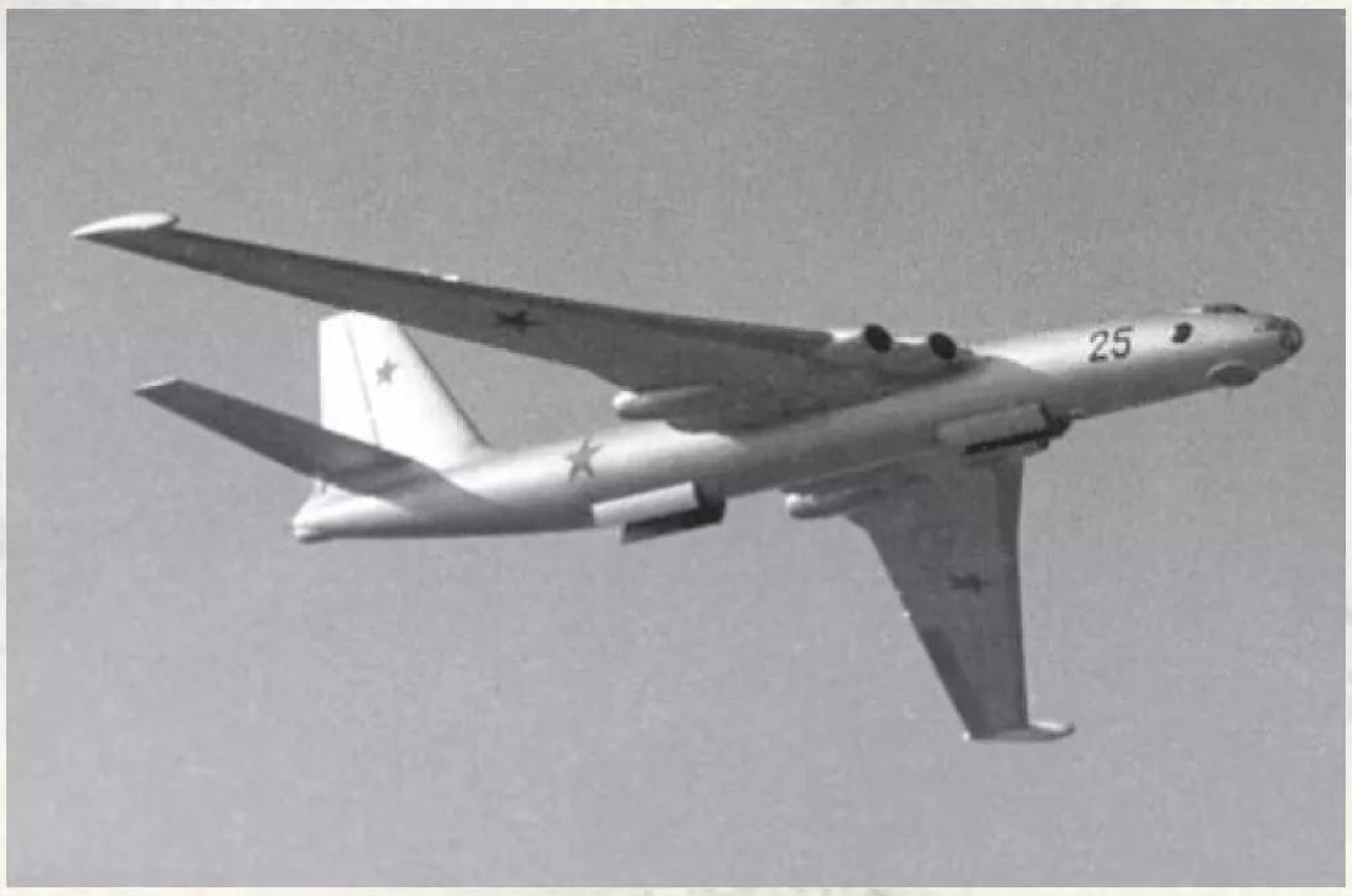
In the directive of 10 July 1952, Tupolev was instructed to make preparation for serial production of Aircraft 88 and that it would be designated Tu-16, that it would receive the codename Topaz and that deliveries should commence in July 1953. With no surprise, the MAP was impressed with the aircraft's rated performance, given that it had a range of 4,390km (2,728miles) carrying a 9000kg (19,845lb) bombload which had been specifically shaped in the performance objectives for carrying Soviet A-bombs. In that role it would have to survive a nuclear flash and air blast and the exterior surface of the Tu-16 had been finished with that in mind.

Some delay ensued in getting blueprints for the lightened version ready and, risking his reputation, Tupolev ordered that version into production rather than the heavyweight design. All the necessary drawings were available by the end of 1952 but with a consequent delay in production until October 1953. But fast-tracking the process and not going through the formal procedures came at a cost to Dmitriy S. Markov, the engineer responsible for lightening the aircraft, when he was subject to a formal and public dressing down and a notice of disapproval placed in his employment record. But his work provided an impressive aircraft and cut time in the certification cycle.

The lightweight 88/2 flew for the first time on 6 April 1953, and Tupolev completed its tests on 12 September. After a series of trials to determine the parameters for the pilot's notes, the 88/2 was cleared as the production model. Much more development lie ahead and over time more than a dozen variants of the Tu-16 would emerge. The initial production Tu-16 made its first public appearance at the 1954 May Day parade and again at the 1955 Tushino air display. None of these could carry nuclear weapons but that capability came with the Tu-16A, of which 453 would be built.

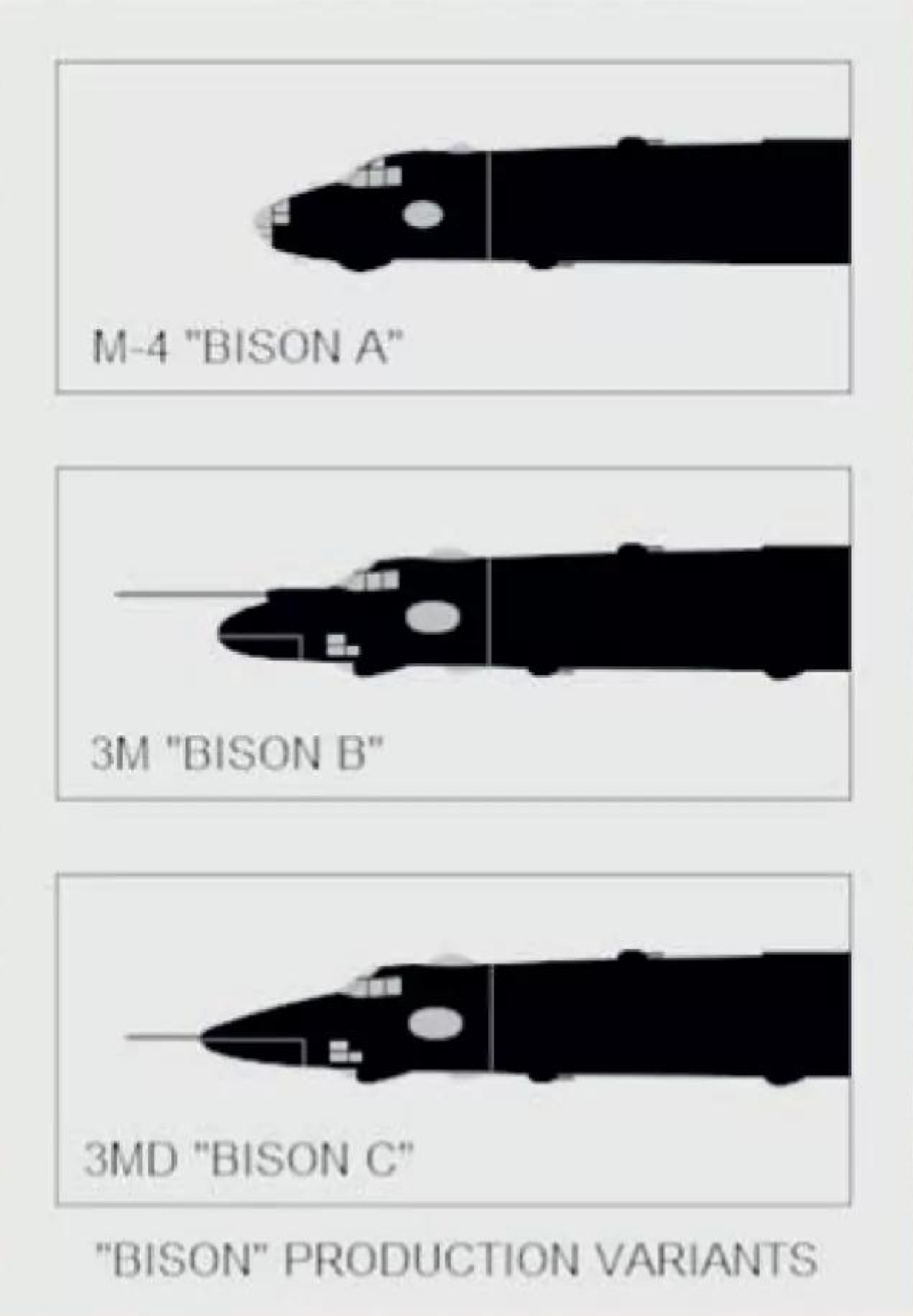
THE STRATEGIC JET BOMBER

The incentive for Russia to have a long-range, jet-powered strategic bomber in sufficient numbers to threaten the West originated with Stalin's perception that his country was under threat from attack. Fuel



The prototype M-4 made its first flight in January 1953. (*Yefim Gordon via Tony Buttler*)

An M-4 at Ukrainka air base displays the acute nose-high pitch angle at rest on its tandem landing gear. (*Boris Vasiljev*)



Bearing the NATA code name Bison, the M-4 had several nose changes as shown here. (*Greg Goebel*)

for that came from three separate directions.

The first was the consistent assertion from high-ranking German officers captured at the end of the war that they expected the British and the Americans to join with their depleted forces to press forward to expel Russian troops from Eastern Europe and to invade the USSR. However naive and incredulous that sounds today, to the ears of a paranoid autocrat it was noteworthy. This belief, more an assumption based on the last-ditch attempts by those fearing retribution to turn their bestial regime into a moral crusade to save Europe, was built on rumour and half-truths.

Second, Stalin was aware that in April 1945 the then British Prime Minister Winston Churchill had asked the War Department to raise plans for a combined ground and air offensive against the USSR, should some form of military action be required by political events in Eastern Europe. Known as Operation Unthinkable, it was stimulated by Churchill's fear that the Russians would occupy Greece and unseat what he considered to be the foundation of Western democracy, however subjective an interpretation of history that was.

The final conclusion of the report handed to Churchill on 8 June 1945, was that such an operation would rapidly escalate into World War 3, although the successful detonation of the first atomic bomb five weeks later added plausibility to his belief that this would give the West incredible leverage over the numerical superiority of the Red Army. Stalin became aware of this report through informants working for the British government and it alone did nothing to dilute concerns when it specifically called for using German army and SS troops to bolster allied forces in any campaign against Russia.

Third, quickly after the defeat of Japan, the United States recognised the need for demobilisation and rapid conversion of a wartime economy into a domestic consumer marketplace. At the end of the conflict it had 12.1 million men and women in uniform, yet by June 1946, only 2.5 million remained in service. With not a little pressure from the British, who absolved the Americans of any moral reluctance to rely on nuclear weapons rather than massed armed forces, a rapid evolution toward the concept of massive atomic retaliation began to unfold.

Accepting this, in 1946, a secret US policy document began circulating under the code name Pincher as a strategy for engaging any Soviet incursion beyond the borders in Europe defined at the Yalta conference of February 1945. This was a defensive planning solution, as was a further study, Broiler, in 1947 which estimated the Russians could mobilise 245 divisions and achieve technological parity with the West including the use of nuclear weapons by 1952. Which is a prescient forecast, two years before Russia detonated its first A-bomb.

Mobilisation for war under Broiler stated the need for a major strategic offensive, with 34 A-bombs dropped on 24 Russian cities including seven on Moscow. In reality, there were far fewer than 25 of the assumed total of 100 such bombs available, most of which were in components requiring assembly over several days. In the first few years after the end of the Second World War, US atomic weapons programmes were anything but robust as reliable devices for conflict. Their operational deployment came slowly, frequently with great confusion and uncertainty among service personnel and technicians not adequately structured for their use. Nevertheless, the plans kept on coming.

Broiler was followed in 1948 by Halfmoon, renamed Fleetwood, which became the first war-fighting policy document to fully integrate the use of atomic weapons in any future conflict. At the turn of the year it morphed into Trojan, in which it was estimated that 133 atomic bombs would be dropped on Russian cities. This in turn evolved into Offtackle, originating through a document from General Dwight D. Eisenhower, then chairman of the Joint Chiefs of Staff, calling for 292 A-bombs to completely destroy 85% of Russian industry. The belief that the threat of all-out atomic retribution would supplant the need for conventional armed forces would dominate the Eisenhower presidential years between 1953 and 1961.

Offtackle quickly led to Operation Dropshot, a 1949 plan for all-out ➤

A line-up of Russian Tu-16s. More than 1,500 examples were built and the Chinese bought more than 230, badged as the H-6 of which about 176 remain in service today as China's only strategic bomber. (*Author's collection*)

war with the Soviet Union, triggering an escalation of intent from the US Strategic Air Command (SAC), custodian of the nation's nuclear attack instrument under the US Air Force. The opportunities afforded by these highly detailed plans were engaged by SAC commander General Curtiss LeMay who consistently throughout his service career supported the view, and verbally endorsed, a pre-emptive strike on the USSR. In 1954, he would tell a pilot shot at and during an overflight of Russian airspace: '… if we do this overflight right, (maybe) we can get World War III started.' Two years later LeMay began a round-the-clock full alert for SAC units.

If not in detail, all these developments were known to the Russians and fuelled Stalin's concern over threats to the USSR, encouraging haste in the development of reciprocal atomic forces and urgency in developing ways to strike the United States and its Western allies. When the war in Korea began on 25 June 1950, it convinced the communist regimes in Russia and China that they were challenged in their own countries by the expanding capabilities of Western countries. For China it threatened their hegemonic and long-term strategies for expansion and for a brief period united their political struggle with that of the Soviet Union.

Thus it was, as early as 1947-49 there was a driven commitment in the Soviet leadership to push forward with a strategic bomber capable of threatening airspace which for that period was largely dominated by American air power. For taking any future conflict deep into the continental United States the Russians needed a long-range jet bomber capable of carrying nuclear weapons. The only credible means of achieving that was the aging Tu-4, the redesigned B-29A adapted for Soviet manufacturing techniques and operational practices.

The days of the piston-engine bomber had gone and the demise of that powerplant was rapid in the United States, with the B-29/B-50 generation and the post-war B-36 now on the way out. Even the B-35 flying wing could not survive and its jet-powered successor, the flying-wing YB-49 was similarly redundant. From the Soviet perspective, as noted previously, the early stages of the Korean War had vindicated the need for a fast, long-range bomber with some level of vulnerability reduced through the additional speed that came with jet engines.

As noted previously, there was opposition to the push for long-range, swept-wing bomber designs on the basis that flutter which occurred with these wings at high speed was not properly understood and that it could prove disastrous if the industry went down that road. But Myasishchev was supportive of swept-wing designs and contradicted Tupolev who had strong reservations, based largely on his uncertainty regarding Soviet jet engines then in development. Myasishchev was an outlier and attracted more than his fair share of opponents, his demotion to head of fixed-wing designs at the Ministry Aviation Institute placing him in a vulnerable position. But that was about to change.

BACK IN FAVOUR

Throughout his time at the MAI, Myasishchev had worked with TsAGI to study these challenges and, with the help of his colleague Nazarov, he drew up the concept of a strategic bomber with high aspect-ratio, swept-back wings and jet engines. TsAGI showed interest in this and that triggered the feasibility study of a strategichesky dahl'ny bombardirovschchik (strategic long-range bomber), or SDB. Although still employed at the MAI, Myasishchev could never be accused of thinking small – his preferred layout involved a high mounted, swept-wing configuration with four AMRD-03 turbojet engines, a take-off weight of 110,000kg (242,504lb) and a maximum bomb load of 20,000kg (44,092lb). With a 5,000kg (11,023lb) bomb load, range was calculated to be 12,000km (7,458miles).

Support for his SDB put Myasishchev back in favour and, based on his earlier reputation, re-established himself within the pantheon of Soviet airframe design teams, approval being given to proceed with that concept under a directive of 24 March 1951. This alone attracted a wide range of graduates to OKB-23 and support for the project came from the highest levels, for real and imagined reasons discussed previously. When OKB-23 reopened it was located at Fili, then a suburb of Moscow but now totally embraced within the environs of the capital. Myasishchev called the project the VM-25, eventually becoming the M-4.

Project design was under the control of Leonid Selyakov with a need to have the initial draft within four months. Four iterations of the original design were proposed, first with straight wings before reverting to the swept configuration, finally with engines placed in underwing pods, two per side in a common nacelle. After further review a fifth configuration had eight TV-2F turboprop engines each driving eight-blade, contra-rotating propellers. Mounted in tandem, the forward engines powered tractor propellers, the aft engines the pusher propellers behind the wing trailing edge.

In yet further revision, a swept-wing design supported six Lyulka turbojets, four buried in the wing roots and two on outboard underwing nacelles but all this did was to significantly increase the weight, which had a bad effect on predicted performance. The seventh iteration took the same design and mounted four AMRD-03 turbojet engines in the wing roots, only marginally shaving off weight which had by now grown considerably beyond original expectations. The next design option was prepared with slightly shorter wings and a maximum take-off weight of 186,000kg (410,053lb) but engine choices narrowed to AL-5 or AMRD-03s.

The largest bomber yet to grace Soviet drawing boards, the M-4 brought unique challenges with materials and manufacturing techniques. Several specialist engineering bureau, were put to work developing new light alloys and heat-treatment furnaces were developed to fabricate large elements. To reduce weight, large duralumin panels replaced conventional alloys sheets of small area so as to reduce fastenings and connectors. All this came together with the definitive prototype drawings ready by 1 April 1952.

Great secrecy surrounded all this activity and the West had no indication from any of its intelligence services that a jet bomber of this size and capability was under development. For their part, the Russians had full knowledge of the Boeing B-52, which would make its first flight two weeks later. Contemporary documents and memoirs written long after these events, speak of the fear that NATO and the Western alliance would soon pose a major threat to Russia and the security of the Soviet state. The very existence of the B-47 and the B-52 brought accelerated preparations for getting the M-4 into production.

Preparations for flight tests moved quickly, with the roll-out of the first prototype in December 1952, after which it was dismantled and taken downriver to Zhukovsky. The first flight took place on 20 January 1953, but a range of modifications and changes were required, the schedule compromised to some degree by production of the Il-28. Acceptance trials did not begin until 4 May 1954, with an appearance at the May Day parade taking the visiting dignitaries and military attaches completely by surprise. Passing over the heads of the watching crowds, the prototype was escorted by four MiG-17 fighters. NATO gave it the code name Bison.

After displaying the M-4 in public and to the world, state trials were completed on 5 August 1954, but some shortcomings were apparent and the Air Force began to question the aircraft's suitability. With a full bomb load, maximum range was 6,500km (4,040miles) or 9,800km (6,090miles) with a 5,000kg (11,020lb) load. This was not quite the intercontinental bomber envisaged and a range of technical issues were revealed in the state examination of flight test results and engineering analysis.

However, on 3 July 1955, a further display of air power at Tushino worried the Americans a great deal as they saw what they believed to be 28 M-4 bombers fly over. Former Secretary of the Air Force and a Missouri Democrat, Stuart Symington raised deep concerns that Russia had in production a long-range, jet bomber capable of dropping nuclear weapons with the range (he believed) to hit the United States. This triggered a major increase in B-52 production schedules, increasing output by 35%. Thus began the 'bomber-gap' myth.

What the Americans had actually seen was the first 10 aircraft fly around in a loop and pass over Moscow a second time, followed by eight different aircraft. Their suspicion that the M-4 was in mass production did little to dampen intelligence estimates, which forecast a total of 600 such bombers within a decade. That was based on one U-2 spy flight over an airfield near Leningrad which housed the entire complement of 30 M-4. The deployment estimate was based on multiplication of that deployment over every Soviet airfield capable of operating such aircraft.

Such was the intensity of the race for supremacy that 1954 and 1955 were pivotal years in which both sides sought ways to outclass the other in nuclear strike potential. In the United States, the decision had been made to develop an Intercontinental Ballistic Missile (ICBM) which would emerge as Atlas deployed from 1959, an alternative design called Titan coming fast behind. In Russia, Sergey Korolev had been designing an ICBM since 1953, but progress was slow and there was little belief that it would be an effective system until flight tests began in 1957.

The Soviet air force was convinced that the only effective way to take the fight to the United States would be through a force of manned bombers. Which was a viewpoint mirrored by sentiment in the USA, where the Air Force diehards refused to accept that push-button warfare could ever supplant manned aircraft. In the United States, the Air Force would take control of long-range rockets, including ICBMs and they would be assigned to SAC from the outset, the Navy taking control of the Submarine Launched Ballistic Missile (SLBM) programme with Polaris.

But all this was moot debate in the mid-1950s, as both superpowers sought to out-gun each other, America being the more surprised over the apparent surge in the deployment of Soviet jet bombers capable of striking America and landing at a friendly base before returning home. The reality, was that the Russians had no such capability. That, and the recognition by the Soviet leadership that they were still behind the technological and numerical superiority of intercontinental bombers operated by the US Air Force put urgency into preparations for a new generation of aircraft, realistically capable of surviving in a major conflict. ■

For more, see:
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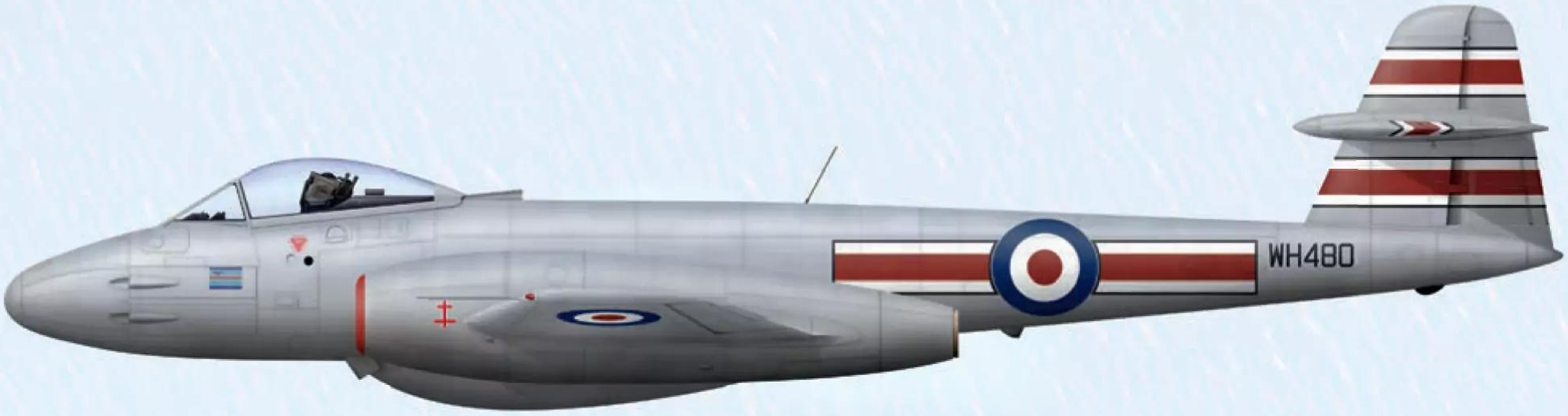
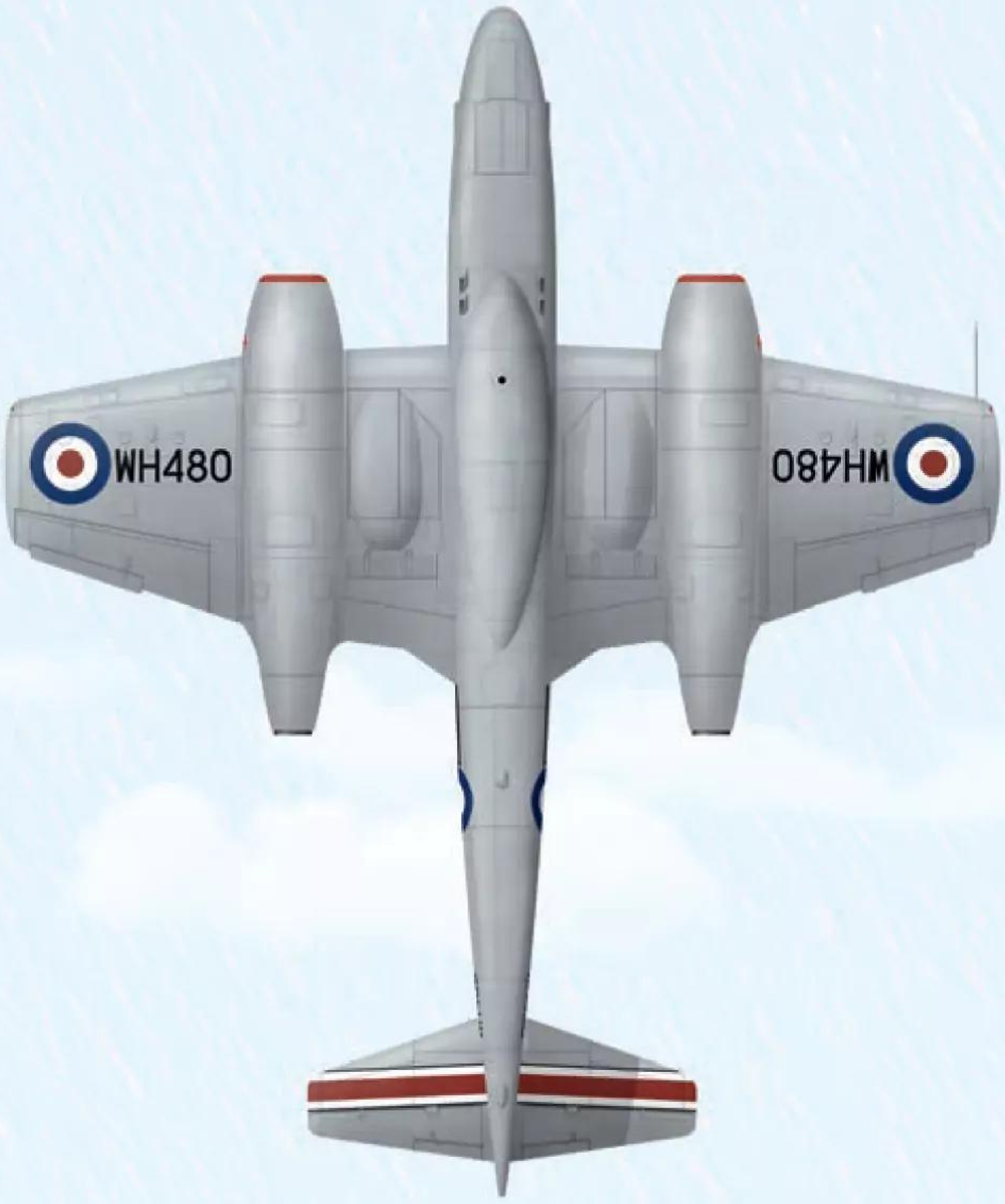


WWII JET IN PROFILE – GLOSTER METEOR

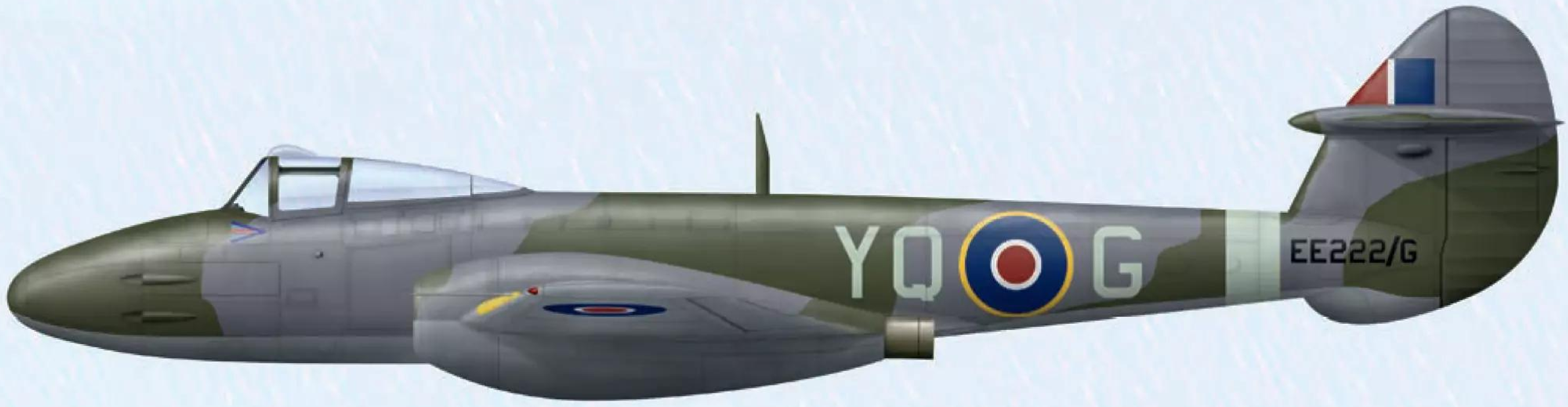
The only Allied jet to see active service during the Second World War was the Gloster Meteor. However, its primary career unfolded during the Cold War. Squadrons were stationed in Germany as the Iron Curtain descended and continued to operate there into the mid-1950s. The Meteor remained in service with the Royal Air Force (RAF) for many years, primarily in secondary roles. By Chris Sandham-Bailey

With the successful early flights of the experimental Gloster E.28/39, which proved Frank Whittle's new turbojet engine, it was evident that the future of combat and aviation lay with the new form of propulsion. At this stage, the output of the engines was insufficient for a single unit to power a fighter on its own so specification F.9/40 called for two engines and armament of four 20mm Hispano cannon (originally six were intended but the weight proved too great). Having already worked closely with Whittle's company Power Jets, Gloster was the logical choice for the design. An initial order was placed for 12 aircraft and eight prototypes were eventually built, DG202-DG209.

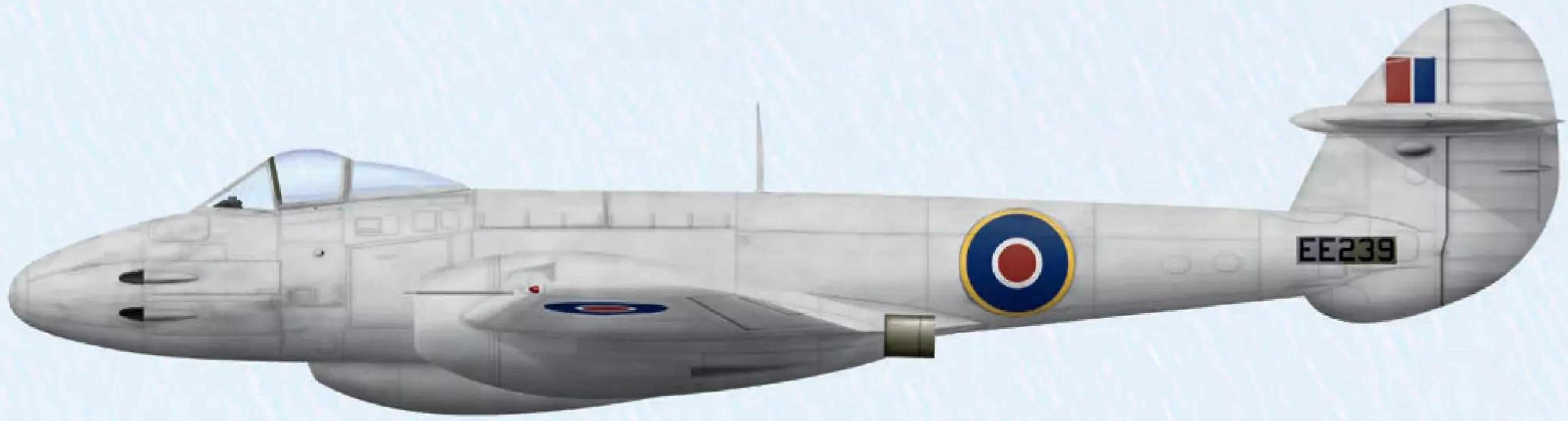
The jet engine's enormous potential was recognised by the Minister of Aircraft Production, Lord Beaverbrook, and Gloster was instructed to concentrate on the new Twin-Engined Whittle Fighter.



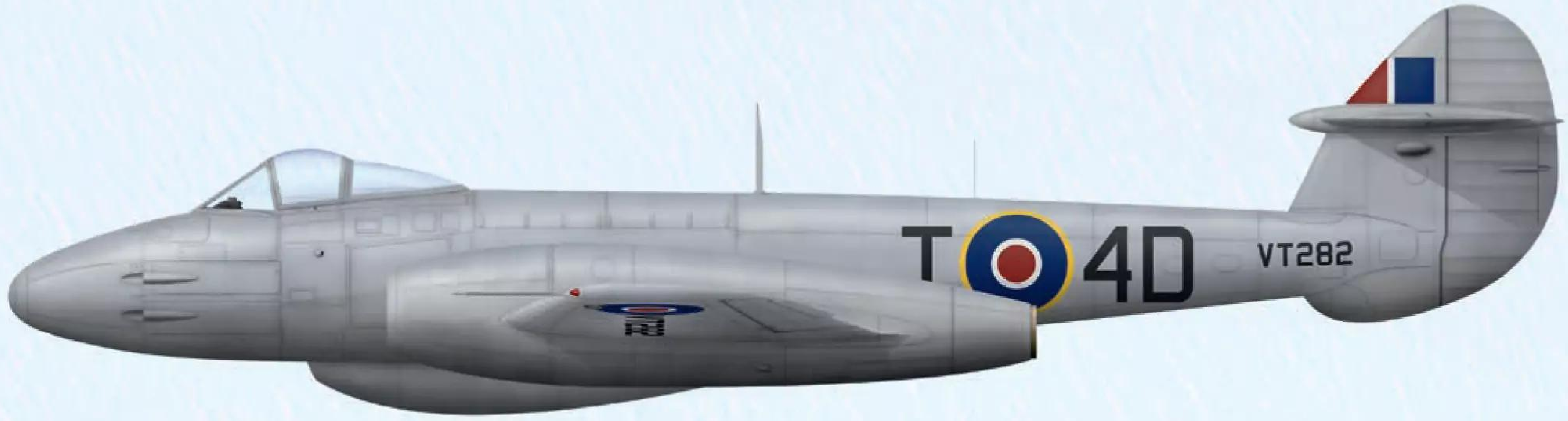
METEOR F.8 WH480 41 SQUADRON
Delivered in January 1952, WH480 served exclusively with 41 Squadron until scrapped in January 1958. The aircraft initially wore bands on its tail but these were later replaced with the fin flash. Finished in all over Aluminium.



METEOR F.1 EE222 616 SQUADRON
Written off following a forced landing due to lack of fuel on August 29, 1944, EE222 is thought to have been flown by Wg Cdr A. McDowell of 616 Squadron. Finished in Dark Green, Dark Sea Grey camouflage with Medium Sea Grey underside and Sky band.



METEOR F.3 EE239 616 SQUADRON
Towards the end of the war, four Meteor F.3s – including EE239 of 616 Squadron – were painted all over White to identify them as non-hostile and help Allied troops become familiar with the new fighter



METEOR F.4 VT282 74 SQUADRON
Delivered to 74 Squadron at RAF Horsham St Faith in October 1948, F.4 VT282 served during the early 1950s. It was converted to a U.15 drone in 1956 and shot down on September 8, 1960, off the coast of Malta while part of 728B NAS. All over Aluminium.

Informally, the project was known as Rampage, then it became Thunderbolt, but with the P-47 in service, the name Meteor was eventually settled on to avoid confusion.

Design and construction was relatively straightforward with the only radical departure from previous aircraft being the engines – the layout chosen was analogous to that of the existing Westland Whirlwind, which had nose-mounted cannon and wing-mounted engines. Resources were scarce in 1941 so the Meteor was designed to make the most of existing machinery and minimal tooling was required for many of its parts.

The first Meteor to fly was the fifth prototype, DG206, on March 5, 1943, at RAF Cranwell. Early testing was beset with complications, two of the prototypes being written off and a third severely damaged.

One major delay was a breakdown in relations between Power Jets and Rover, the latter having been tasked with production of the early engines. In an effort to resolve the difficulties, Rolls-Royce was appointed

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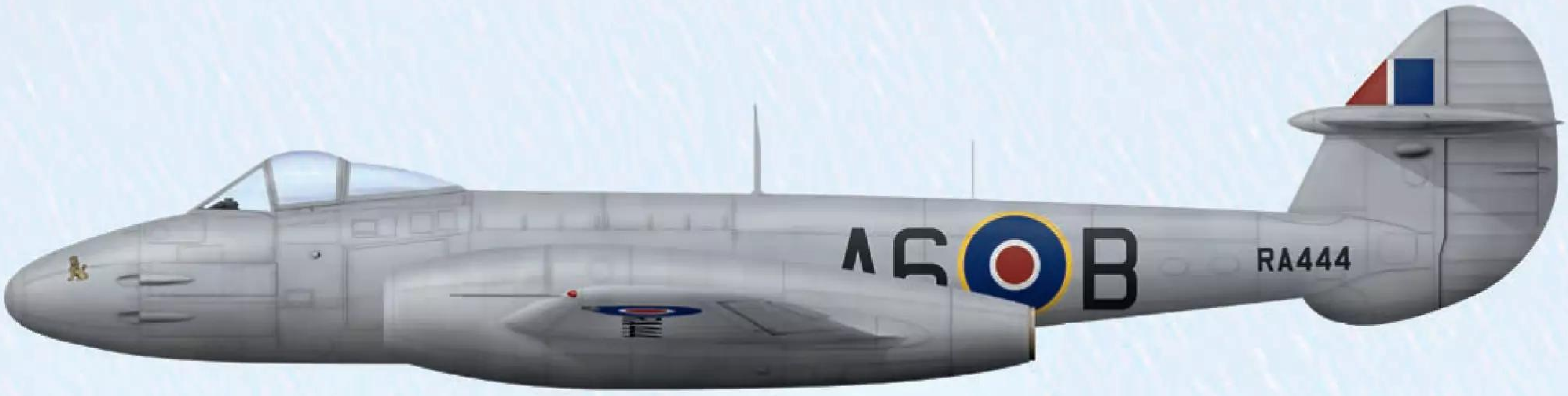
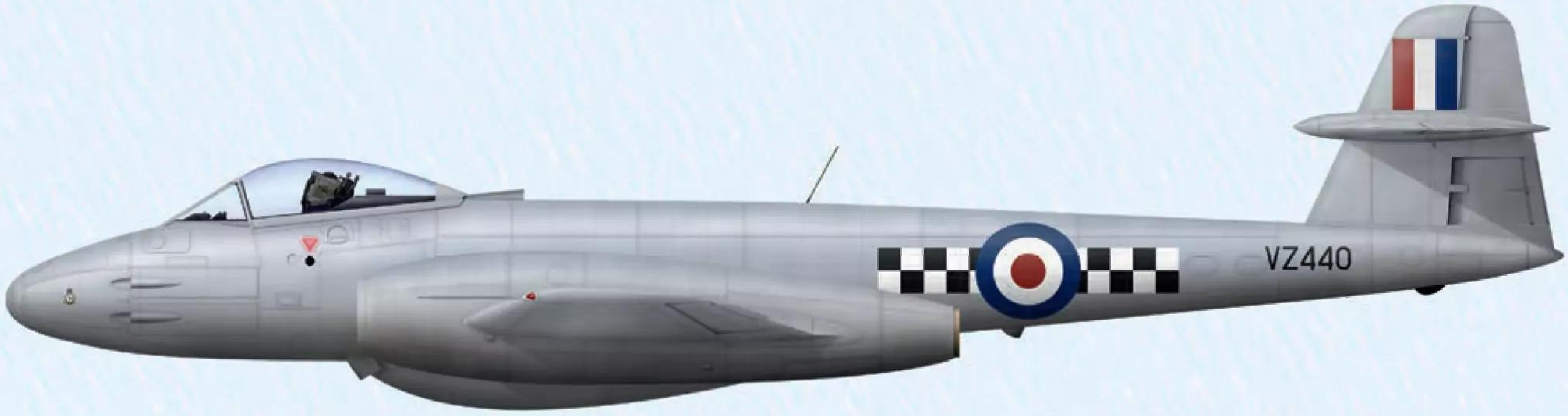
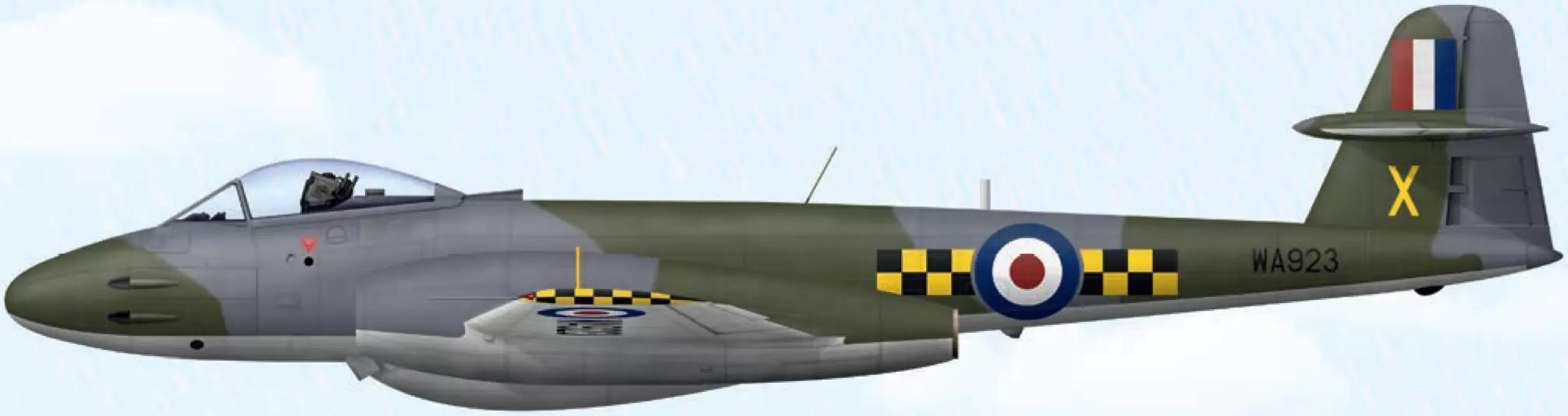


METEOR F.4 RA444 257 SQUADRON
Based at RAF Odiham, 257 Squadron's RA444 was the first jet to land in Dublin – for a demonstration to the Irish Air Corps during May 1948. The squadron logo was worn on the nose.



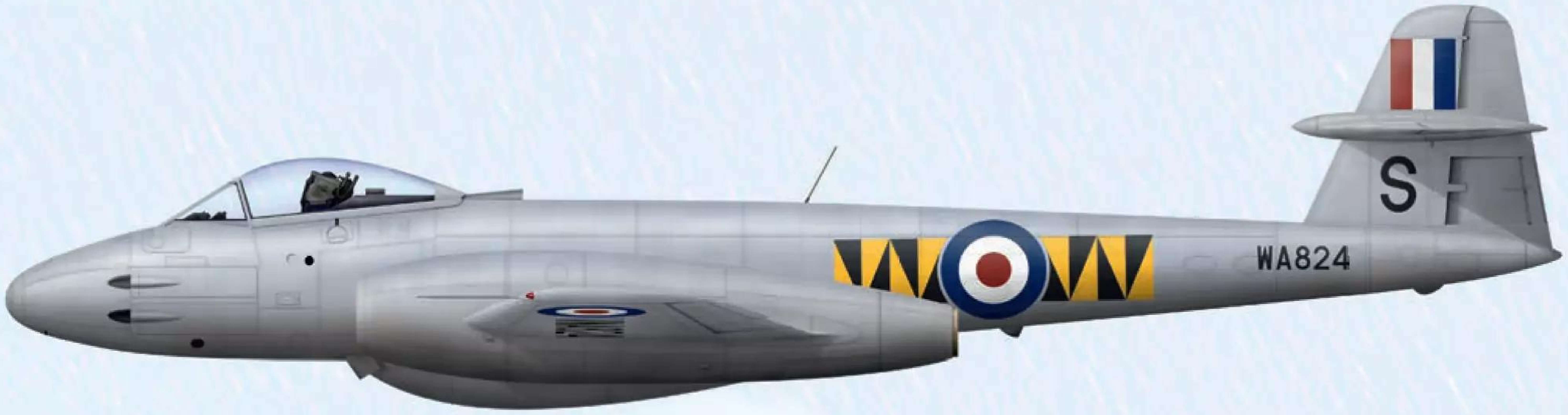
METEOR F.8 VZ440 43 SQUADRON
This was the first Meteor delivered to 43 Squadron in August 1949, it was then allocated to 12 MU where it was scrapped in August 1959. WA829 at Tangmere Museum has been painted up to represent VZ440.



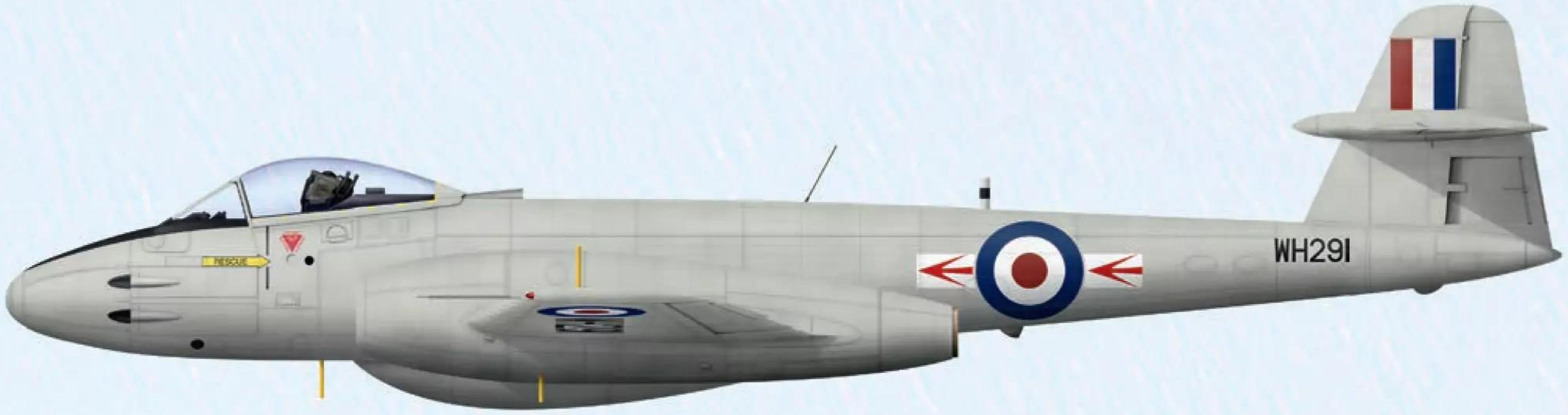
METEOR F.8 WA923 63 SQUADRON
Wearing all camouflage on the upper surface with a distinctive check pattern on the fuselage and wing tips, WA923 was delivered to 63 Squadron in November 1950 and scrapped in February 1958. Dark Green, Dark Sea Grey upper surfaces and Light Aircraft Grey underside

to the project, beginning the company's association with jet engines. 616 South Yorkshire Squadron was the first to convert to the new jet. Initially, two flights retained the Spitfire VII and only the third was equipped with the Meteor F.1, the first pilots beginning their conversion course on June 6, 1944. The squadron was to receive its first Meteors a month later.

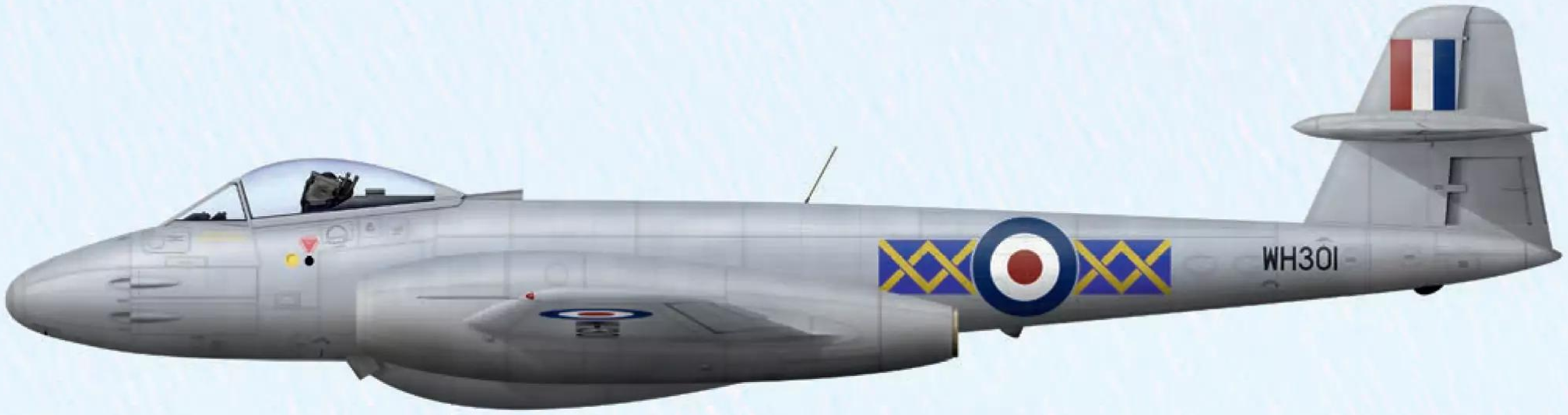
The biggest change for many fighter pilots was the two engines, but the slower acceleration and higher top speed also took some getting used to. Concern that the Germans may be able to reverse engineer the Meteor meant that operations were initially limited to flights over UK soil, 616 Sqn being tasked with intercepting V-1 flying bombs.



METEOR F.8 WA824 74 SQUADRON
Having already operated earlier marks of Meteor, 74 Squadron converted to the F.8 while at RAF Horsham St Faith in October 1950. Until 1956 the aircraft were finished in Aluminium, then they were repainted in camouflage. WA824 appeared as part of a squadron display at the Paris Air Show in June 1956.



METEOR F.8 WH291 79 SQUADRON
WH291 was delivered to 257 Squadron in November 1951. Following a wheels-up landing, it was eventually allocated to 229 OCU at Chivenor and painted in 79 Squadron (shadow unit) markings and all over Light Aircraft Grey during late 1970.



METEOR F.8 WH301 609 SQUADRON
Currently on display at the RAF Museum, Hendon WH301 served with 609 Sqn and later 85 Sqn. Still wearing these markings when it was acquired by the museum, it was repainted in its original markings in 1989.

By the end of the year, the more powerful F.3 began to filter through and in February 1945 a flight of four Meteors was based at Melsbroek, Belgium. Most Allied troops had never encountered the Meteor and it was not uncommon for it to be mistaken for the Me 262. To remedy this, the Meteors each received an all over whitewash. The F.3 served with 15 squadrons and 210 were constructed.

Further developments saw the introduction of the F.4 which had a more powerful engine, the Rolls-Royce Derwent 5 which was itself a scaled version of the new Rolls-Royce Nene. Extended intakes also allowed for a higher top speed and much greater rate of climb.

The F.4 was also found to be a lot more manoeuvrable and amenable to

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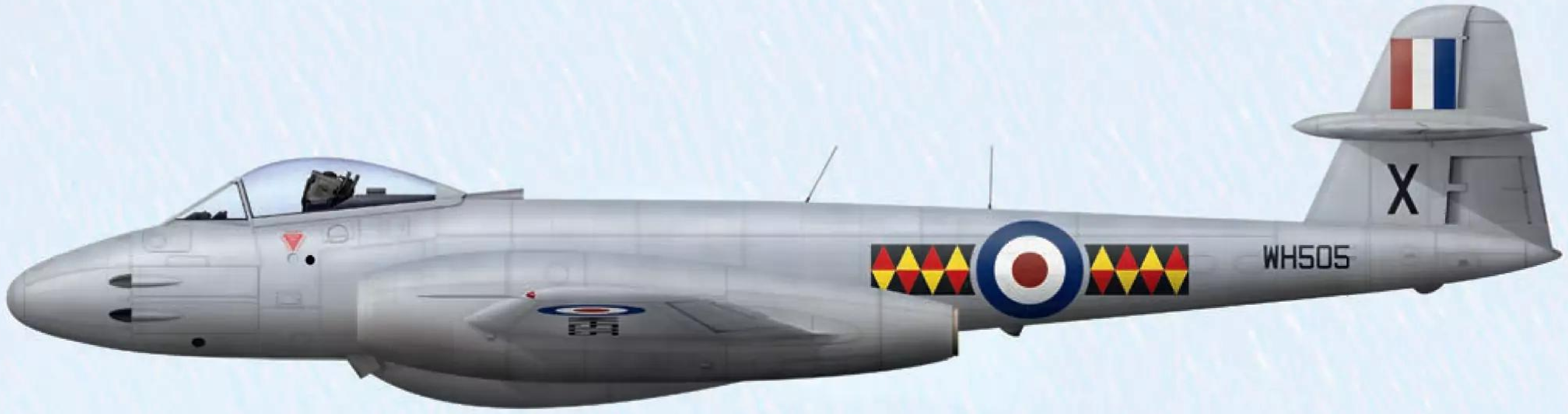
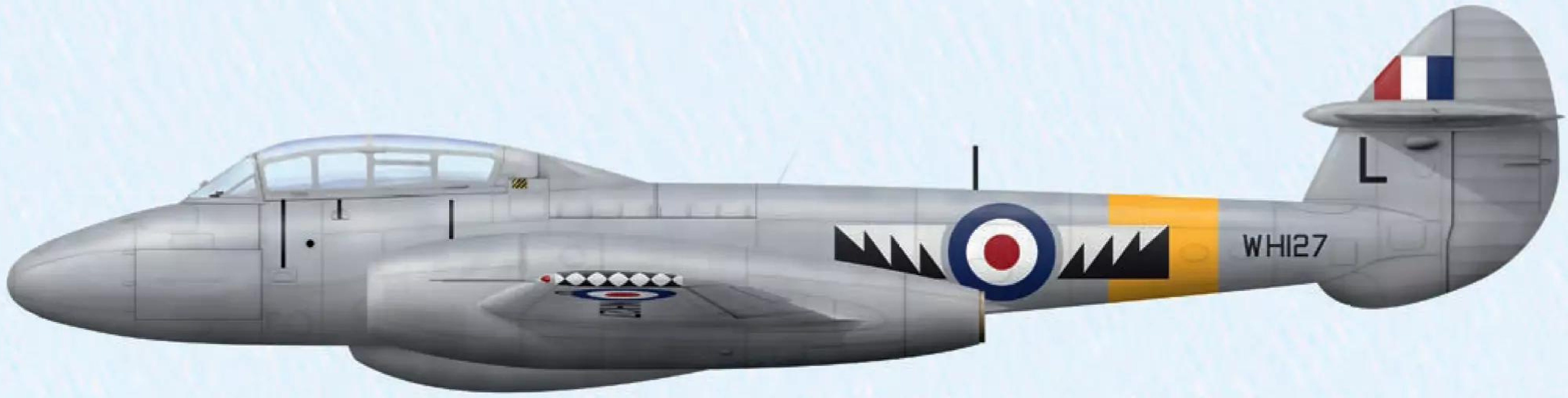
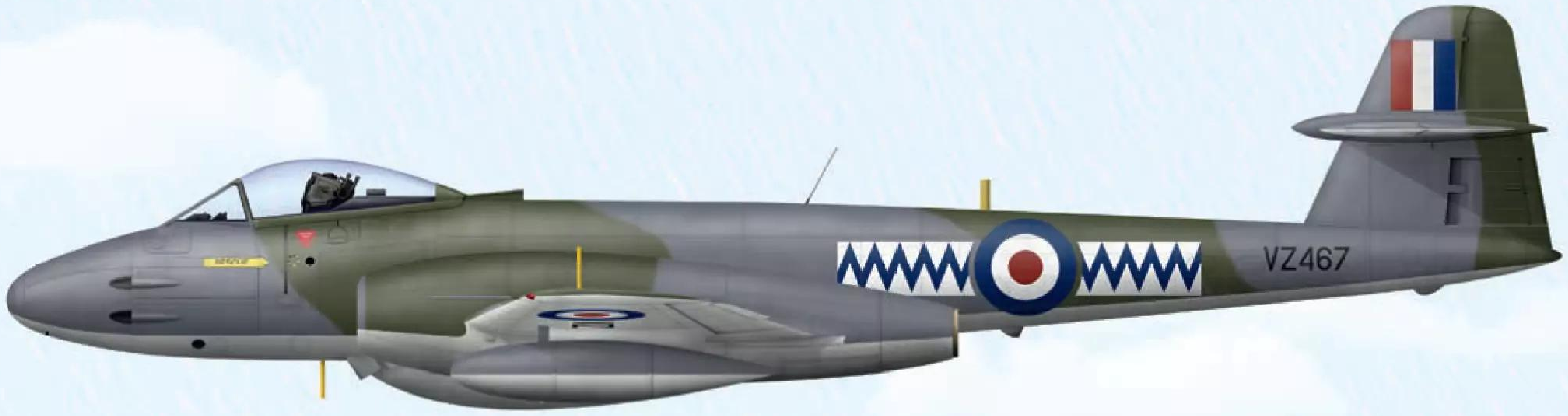


METEOR F.8 WH505 611 SQUADRON
Flown by the leader of 611 Squadron during 1952, WH505 was later converted into a U.16 drone and written off on September 27, 1962.



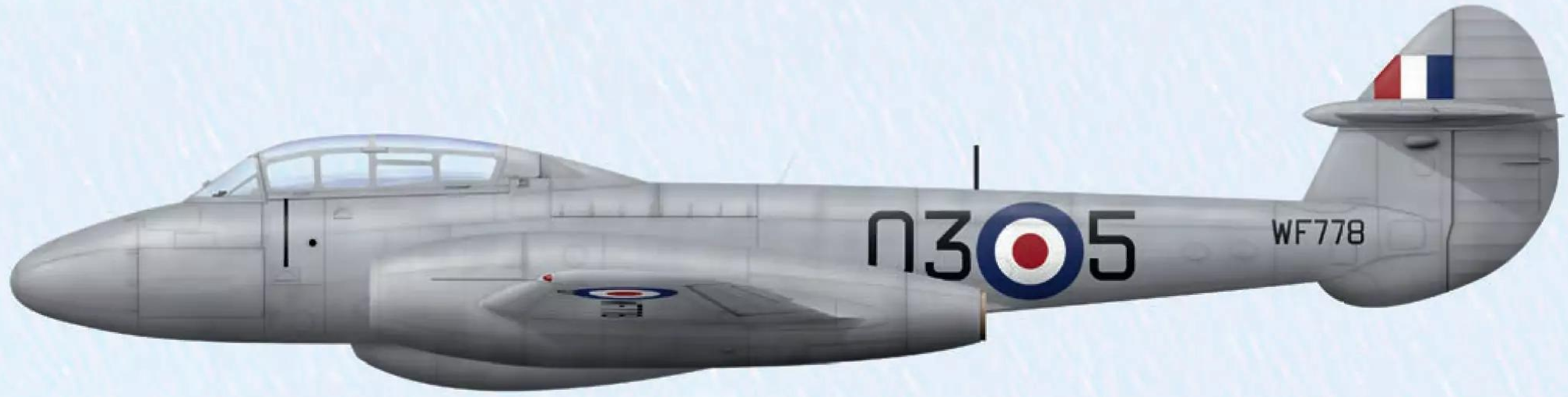
METEOR T.7 WH127 610 SQUADRON
Based at RAF Hooton Park, 610 Squadron was equipped with the Meteor F.4 and F.8 but also had some trainers including WH127. Following disbandment in 1957, the aircraft was allocated to a training unit and struck off in October 1963.



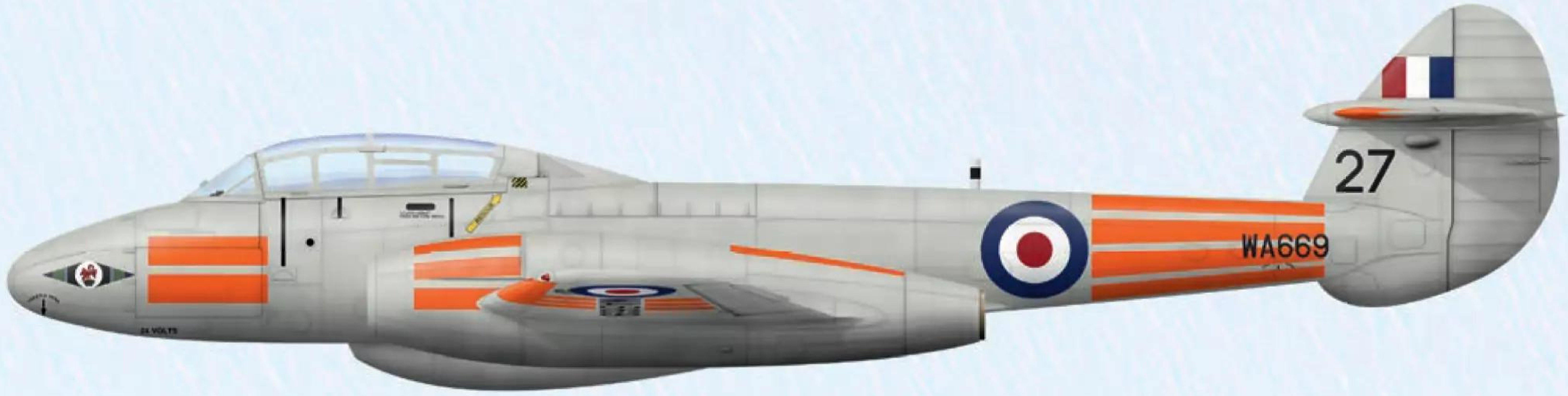
METEOR F.8 VZ467 615 SURREY SQUADRON
Based at 1 TWU RAF Brawdy, VZ467 'Winston' was supposedly painted in 615 Squadron colours for an intended flypast for the 100th anniversary of Sir Winston Churchill's birth in 1970. The scheme was retained until it was retired. Now in Australia as A77-851 and the only airworthy F.8.

aerobatics, even being able to execute them with only one engine, an indication of the swift progress made. Rapid advancements by Gloster's competitors meant that subsequent iterations had to be radically overhauled to keep up. This led to the F.8 – the final single seat fighter version of the Meteor.

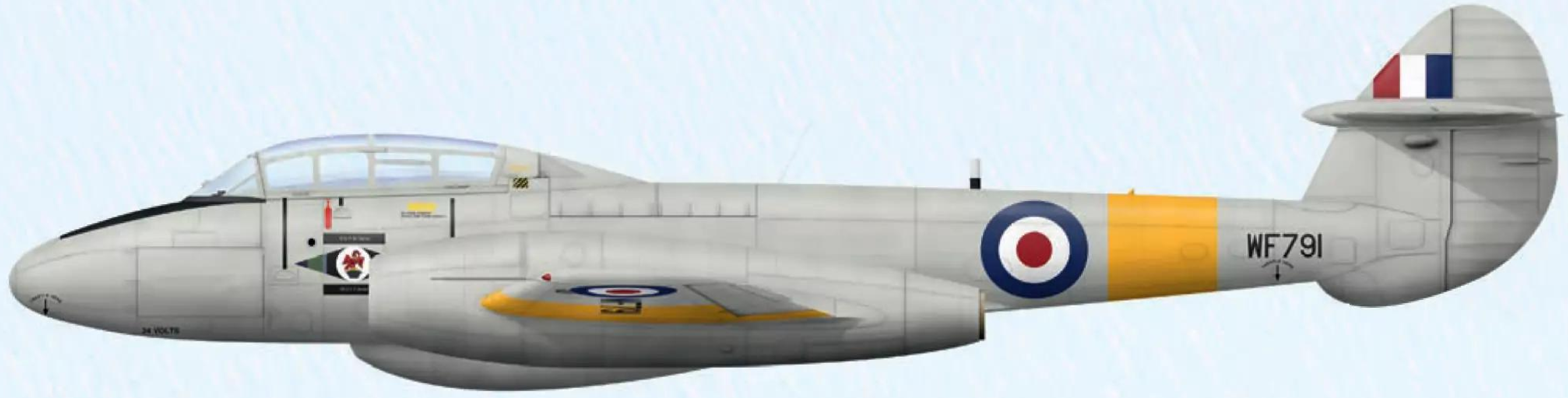
Initially, experienced piston-engine fighter pilots were given a cursory tour of the cockpit and a copy of the pilot notes then told to get on with it. However, it soon became apparent that pilots found the change to flying jets a considerable challenge. So Specification T.1/47 outlined the need for a dual control jet trainer to reduce the number of accidents caused by unfamiliarity. F.4 G-AKPK had already been used as a company demonstrator and was selected for conversion.



METEOR T.7 WF778 613 SQUADRON
Despite 613 Sqn being a Vampire unit, WF778 was kept on strength between April 1951 and February 1957 for pilot assessment.



METEOR T.7 WA669 CENTRAL FLYING SCHOOL VINTAGE PAIR
WA669 was one of two T.7s flown by CFS pilots with Vampire XH304 from the formation of the Vintage Pair display team in 1971. WA669 and XH304 were involved in a mid-air collision on May 25, 1986, at RAF Mildenhall. All over Light Aircraft Grey with Day Glo bands.



METEOR T.7 WF791
Delivered to the RAF in March 1951 the aircraft was displayed by the CFS first as part of the Vintage Pair and latterly as a solo display until it was written off at Coventry on May 30, 1988.

The fuselage was extended to accommodate the pupil and the aircraft (now designated T.7) flew in this configuration for the first time on March 19, 1948. Another advantage of the lengthening was an improvement in directional stability. For many years, the T.7 was the first experience of jet flight an RAF pilot would have.

Following the war, the RAF needed a replacement for the Mosquito night fighter which would be capable of matching the new jet bombers for speed; this ultimately led to the Gloster Javelin but until then an interim solution was required. Airborne interception relied on a radar operator guiding the pilot on to the intruder so the logical basis for a Meteor night fighter was the T.7.

Despite sounding simple, the

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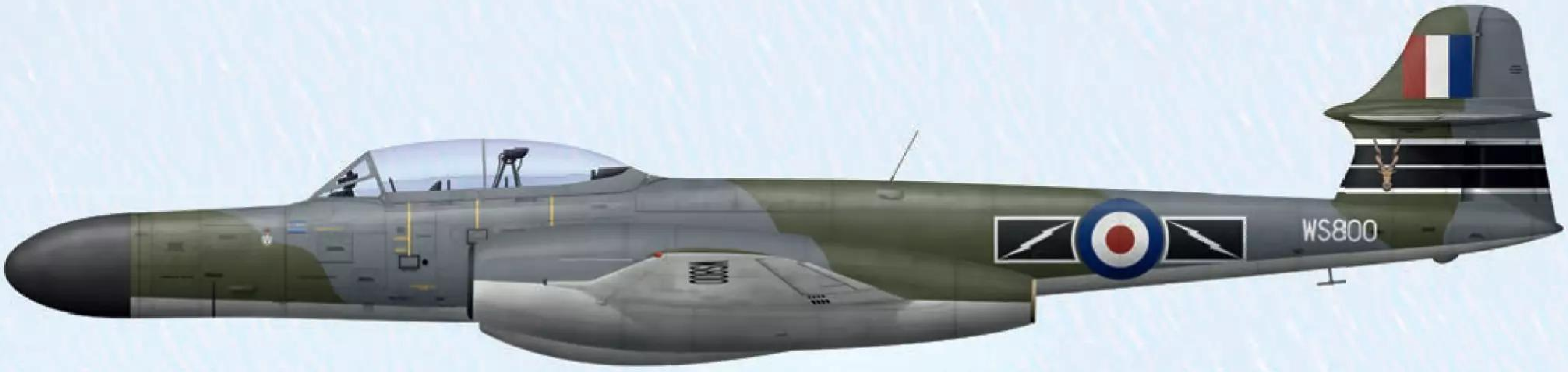
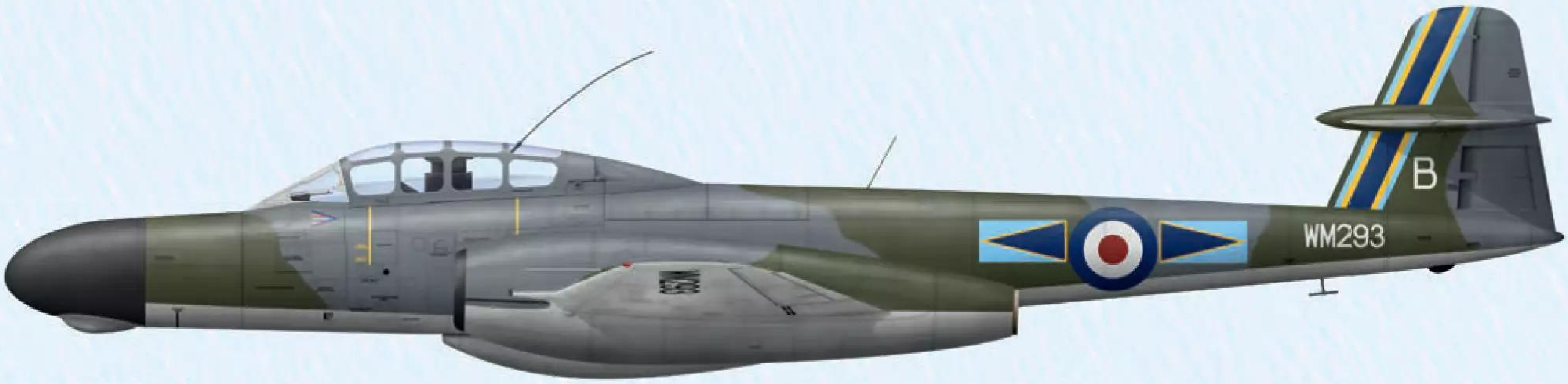
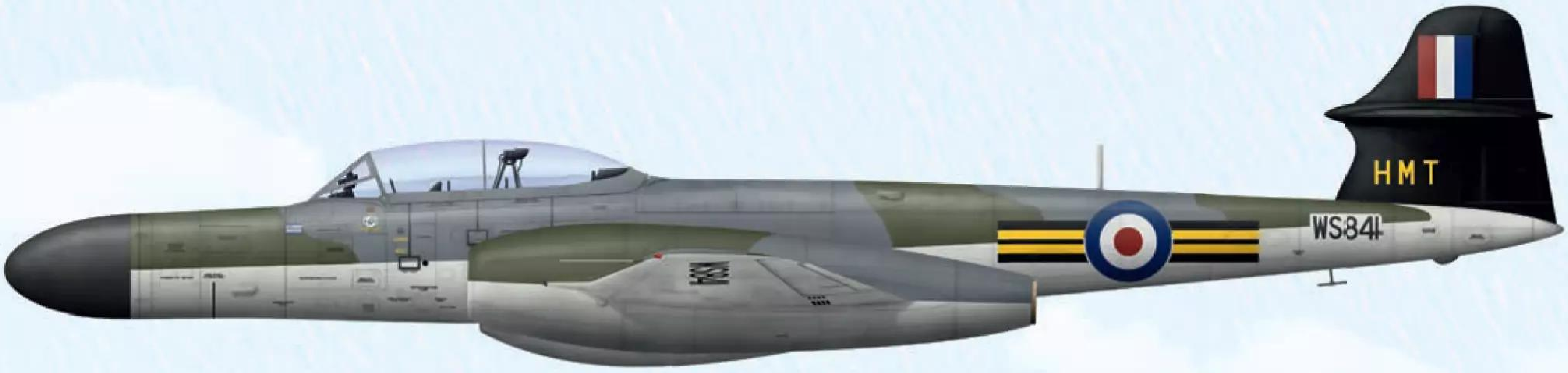


METEOR NF.14 WS800 60 SQUADRON
Based at RAF Tengah, Singapore, 60 Sqn received NF.12s and NF.14s between October 1959 and February 1960. WS800 was one of the first two to arrive and was flown by the squadron CO.



METEOR NF.11 WM293 68 SQUADRON
Wearing 68 Squadron colours on its tail in place of the fin flash, WM293 was flown by the CO while based at RAF Wahn, West Germany.

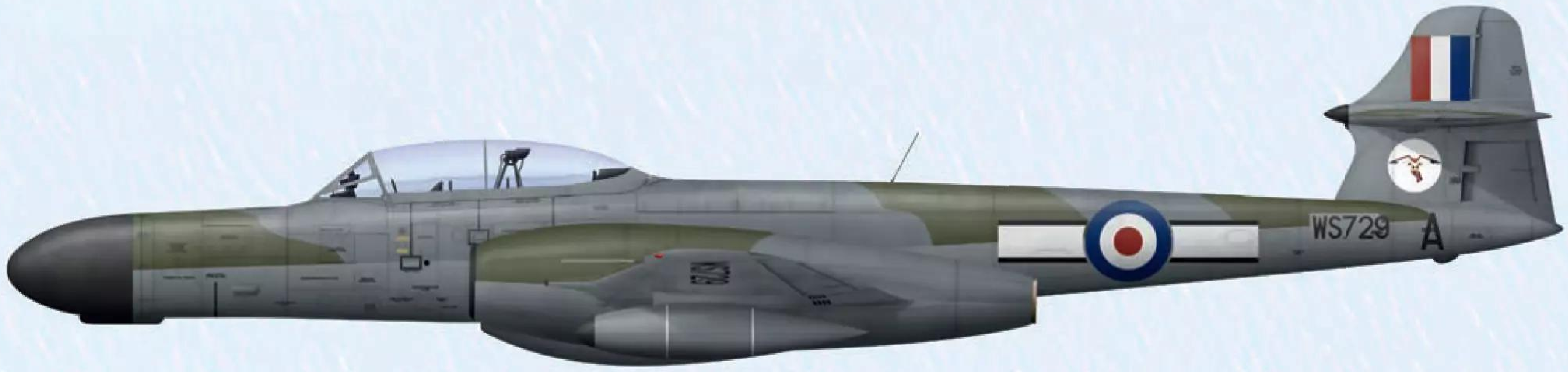


METEOR NF.14 WS841 HMT 264 SQUADRON
The squadron replaced their Mosquitos with the NF.11 in 1951 and latterly the NF.14 during 1954 until disbanded in 1954. WS841 is notable for having an all-black tail.

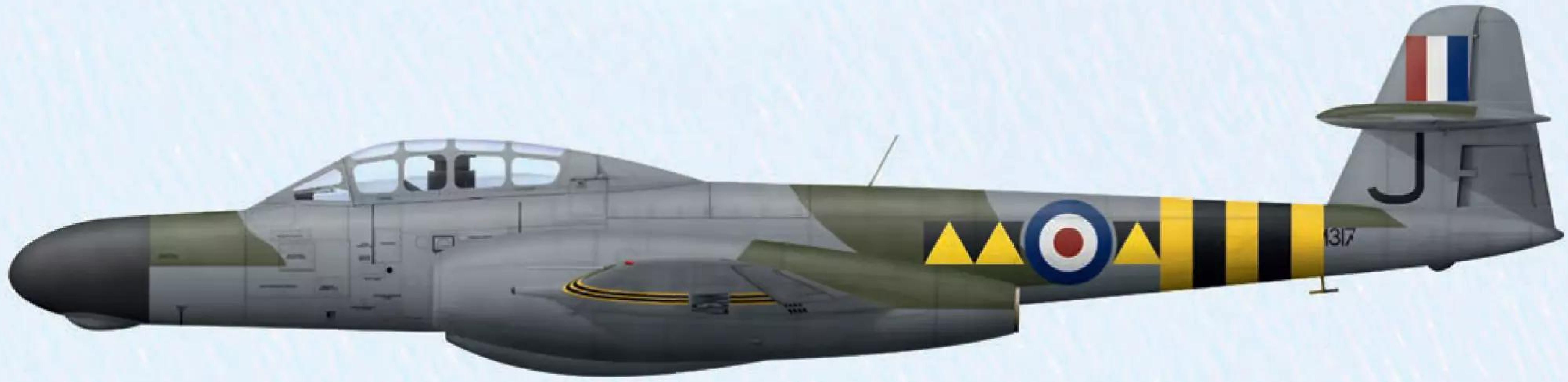
development and introduction of the NF.11 was a protracted affair. With the company's resources already heavily committed to the production of the single seat fighters, the programme was subcontracted to Armstrong Whitworth at Coventry. A number of changes had a substantial impact on the aircraft, radar equipment increasing its weight and requiring both a greater wingspan and the more powerful Derwent 8 engines. The 20mm Hispano cannon were moved into the wing, the nose now containing the radar and a new feature for the Meteor, a pressurised cockpit.

The NF.11 entered service with the RAF when WD599 was delivered to 29 Sqn at RAF Tangmere on August 20, 1951. Before the month was out, a further seven had been delivered. The next version of the Meteor to enter service was the NF.13 (before the NF.12). This was a tropicalised version of the NF.11 with the introduction of air conditioning. It was to serve in Egypt with 39 Sqn and 219 Sqn.

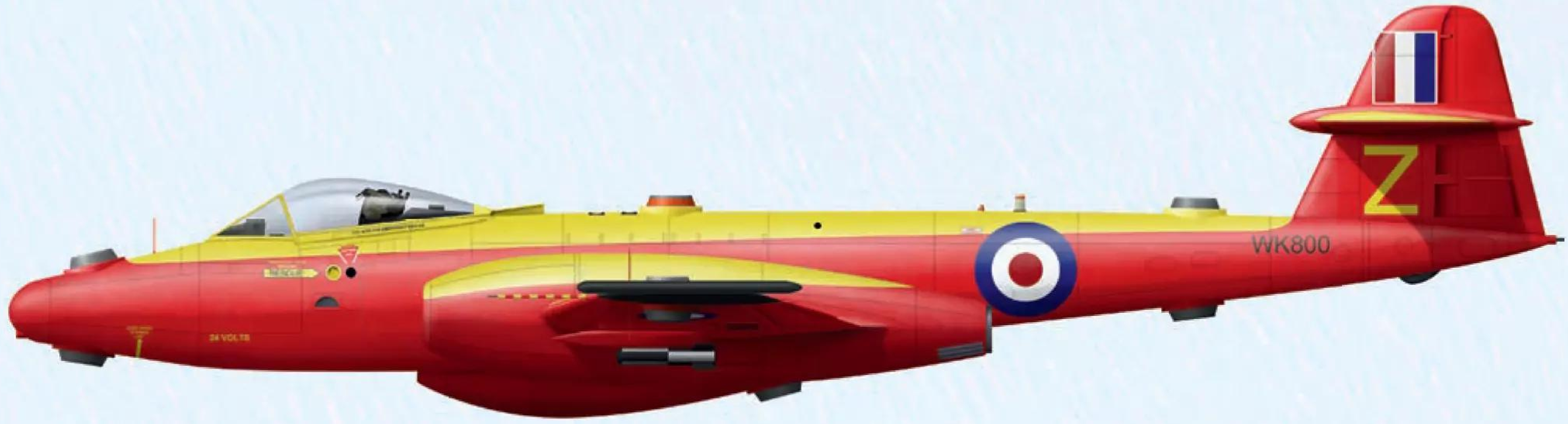
Development of the NF.12 was more complex than the straightforward alterations made to the NF.13. Externally, it received aerodynamic improvements to the tail and nose, the latter being the result of the larger American APS-57 radar. The



METEOR NF.14 WS729 25 SQUADRON
25 Squadron operated a mix of NF.12s and NF.14s from March 1954 until June 1958. WS729 was delivered new to the squadron as part of the conversion process and scrapped in January 1961.



METEOR NF.13 WM317 39 SQUADRON
Wearing the black and yellow identification markings of the Suez Crisis, 39 Squadron were based at RAF Luqa, Malta, but were also at RAF Nicosia during the crisis.



METEOR D.16 WK800
WK800 was constructed as an F.8 and served with the Royal Australian Air Force as A77-876, including time in Korea with 77 Squadron. It returned to the UK in 1971. Reverting to the WK800 serial, it was converted to the D.16 drone configuration and operated at Llanbedr. Painted in gloss Red and Yellow.

canopy and other features remained largely unchanged.

The final iteration of the Meteor was the NF.14 which was a refined version of the NF.12. A new canopy with improved all round vision was added. It also saw a further extension of the nose to accommodate the APQ-4 radar. Many airframes went on to see a second life in a range of roles, some being converted to drones, others being used as target tugs. Along with newly built aircraft a lot of ex-RAF Meteors were exported to the 17 countries which flew the type. It was the very first operational jet produced by the Allies and almost 4,000 were built. ■

For more, see:
RAF Cold War Jet Aircraft in Profile
By Chris Sandham-Bailey
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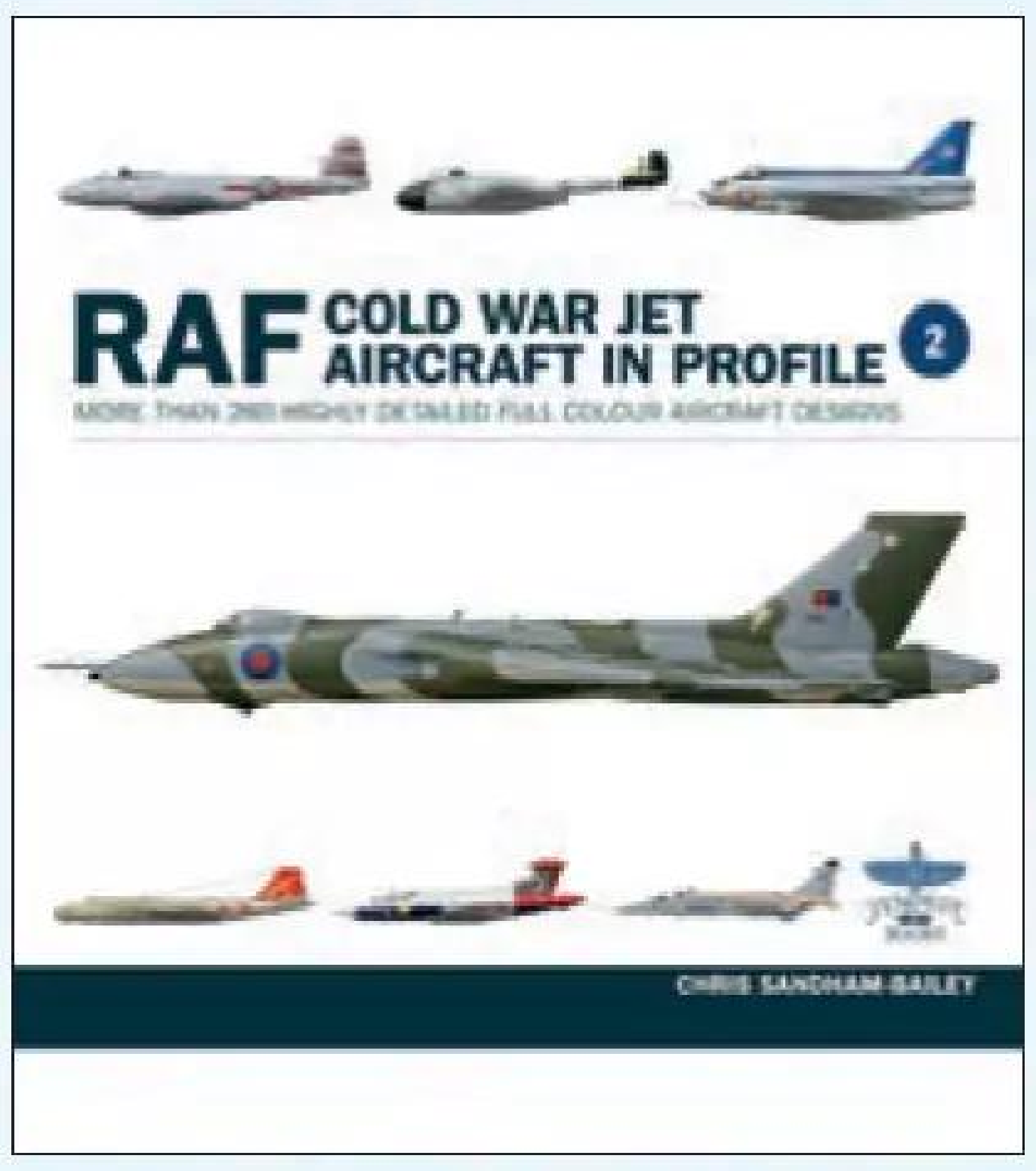

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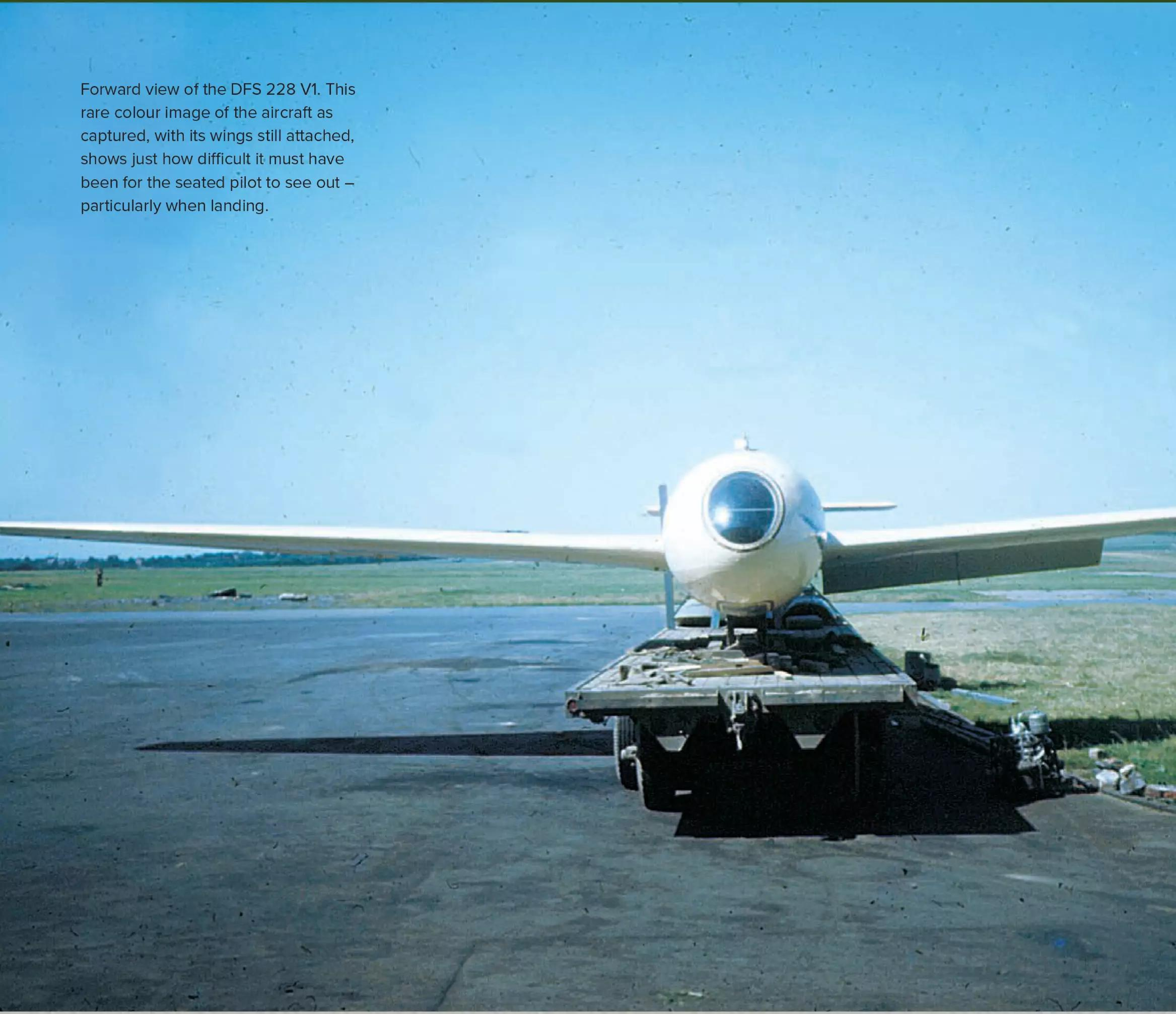

Forward view of the DFS 228 V1. This rare colour image of the aircraft as captured, with its wings still attached, shows just how difficult it must have been for the seated pilot to see out – particularly when landing.

NAZI MACH I AMBITIONS

As the Second World War was entering its last stages, the German Air Ministry (Reichsluftfahrtministerium; RLM) pressed ahead with a three-step programme of research ultimately intended to get a rocket-propelled manned aircraft through the sound barrier, as Dan Sharp explains.

Exactly when the RLM began working on the concept of a programme of research dedicated to studying the effects of high-speed flight up to and through the sound barrier is unclear but it would appear to have been built on the back of an existing aircraft design – the DFS 228.

During the 1930s, German gliders had been able to achieve ever greater altitudes to the point where they reached the limits of human endurance. Pilots were suffering from oxygen deprivation and severe frostbite and something would need to be done to protect them if still higher altitudes were to be achieved.

The background is explained in a paper prepared by DFS glider construction institute leader Felix Kracht for the Deutschen Akademie der Luftfahrtforschung (DAL), the German Academy for Aeronautical Research in 1944, entitled 'Gedanken über Entwicklung eines Flugzeuges zum Einsatz in extrem grossen Flughöhen' or 'Thoughts about developing an aircraft for use in extremely high altitudes'.

He stated that attempts to glide higher "were interrupted shortly after the beginning of the war, as more urgent and immediate tasks came to DFS; but the deeper reason is to be found in the fact that as early as 1940 the limits of the available aircraft were achieved. The ability to substantially exceed 11,600m altitude seems to be within reach according to meteorologists, but requires a flying device that allows the pilot of the aircraft to remain at these heights.

"The normal oxygen system with oxygen mask is no longer sufficient for these heights. So for these research flights a glider would need to be equipped with a pressurised cabin. But that would necessitate the development of a new type of aircraft.

"In spite of the burden of other things, DFS tackled the solution to this problem, which was a familiar one, and worked on the development constructively. War conditions, however, slowed the execution. Only the pressurised cabin was built, as there was a significant interest in its testing. This was prompted by considerations about the ability of a glider or a plane of comparatively low weight to lift ratio with short-duration engines to reach heights which are outside the reach of existing warplanes. In the event that such an aircraft still has sufficient performance when it reached its target altitude, it was planned to use it at that height as an unarmed reconnaissance aircraft."

This account of why a high-altitude pressure cabin-equipped glider needed a rocket motor – so it could reach high altitude fast enough to avoid any chance of interference from enemy fighters – skips rather lightly over what was really a lengthy and difficult development process.

The unattributed June 18, 1945, document Bericht über Aufbau und Arbeiten des Instituts für Flugzeugbau (S) der Deutschen Forschungsanstalt für Segelflug "Ernst Udet" e.V., probably also written by Kracht, explains that the first of the 'new type of aircraft' in question was the DFS 54 – an unpowered glider fitted with a pressure cabin. Work on this started in the autumn of 1940. The document says: "Development and construction research [for the DFS 54] were finished and the construction of the sample aircraft was about 80 per cent completed. Later, the construction had to be stopped due to the war situation. All constructional parts are in Prien. According to the original plans the completion of the aircraft would take about two to three months, but it has to be considered that the design of the model has been improved by later development research."

The DFS official progress report for September 1942, shows work on the DFS 54 still in progress, stating: "Development of a glider for high altitude. The density tests with the cabin were continued. The breakage test gave a breaking strength of 1.1 atmospheres. Taking into account that the shell was made with 2mm plywood instead of 2.5 and the fibre direction of the planking was unfavourable, the result is very satisfactory, since the operating pressure is 0.6 atmospheres maximum and a safety J = 1.8 has already been achieved in the cabin as built.

"Further, the whole cabin construction was finished. The cable lead-through and the hood locks have already been tested. In addition, investigations were made into whether it is possible to disembark such a special-purpose aircraft."

The earliest known mention of the DFS 228 – essentially the DFS 54 but now fitted with a rocket motor and fuel tanks in addition to its pressure cabin – comes from the DFS official progress report for August 1943, although in all likelihood work must have started somewhat earlier than that.

Interviewed by historian David Myhra during the 1980s, Kracht said: "Then came the development of the DFS 54. This had been finished about 75% but then we shifted over to the DFS 228. This was because in 1943, we didn't have any time any more for pure civil soaring and therefore, we set the DFS 54 aside for more friendly days. I then devoted my full time to the development of the DFS 228."

The August 1943 progress report states: "Development of a glider for high altitude (DFS 54). The construction of the aircraft was completed in the reporting period. The construction of the pressurised cabin is about to be completed. The cabin is then tested in the altitude chamber of the E-Stelle Rechlin.

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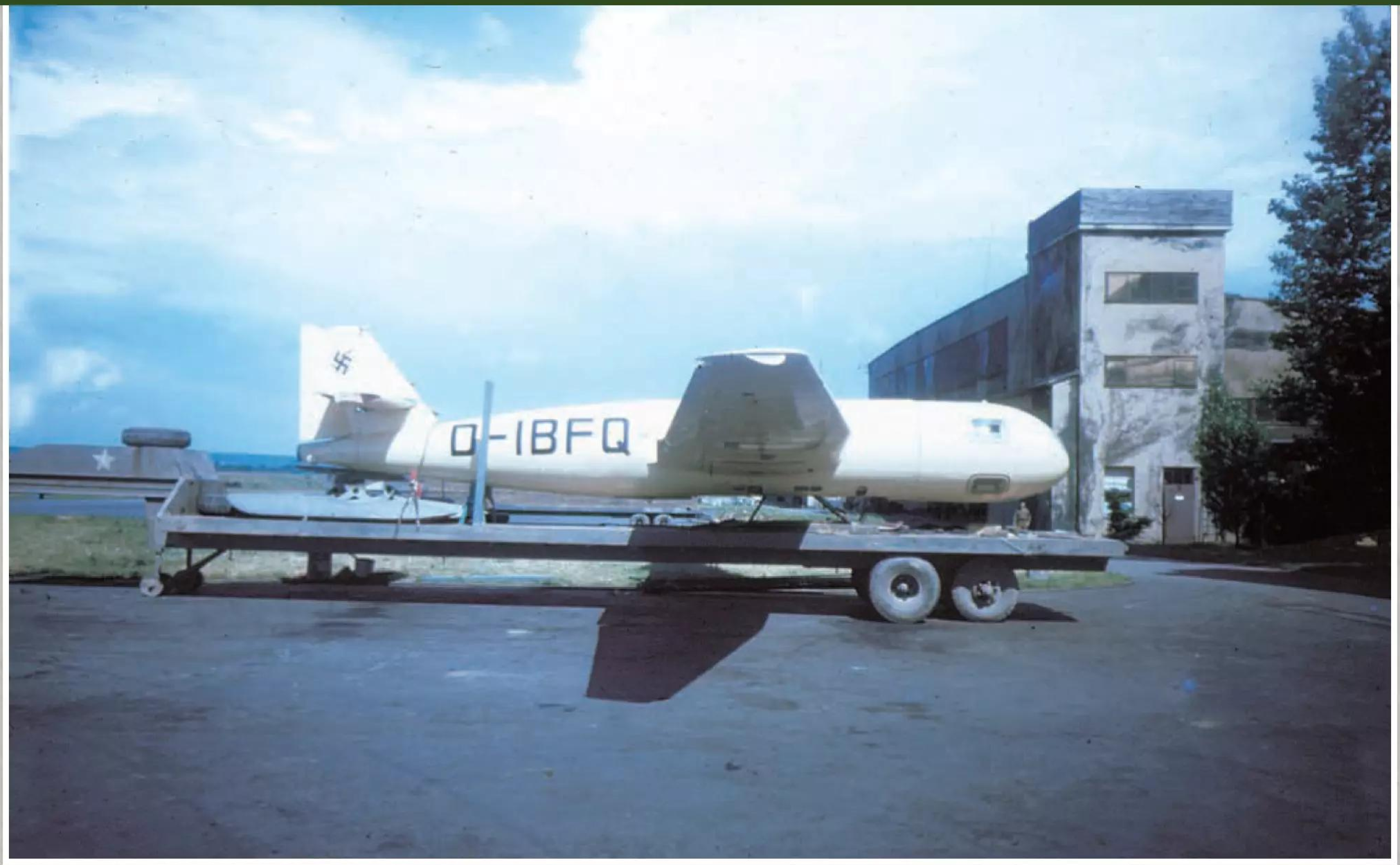
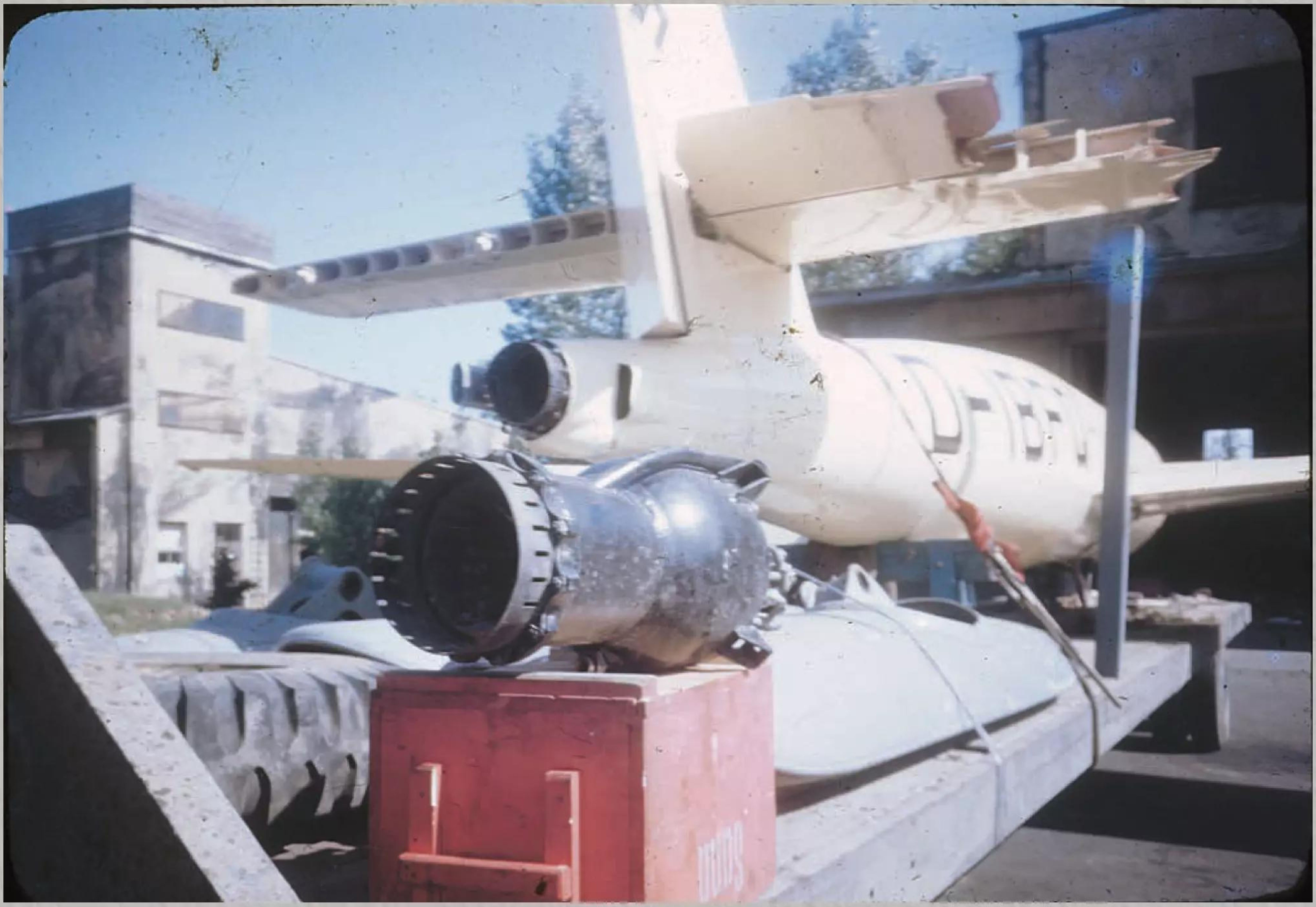
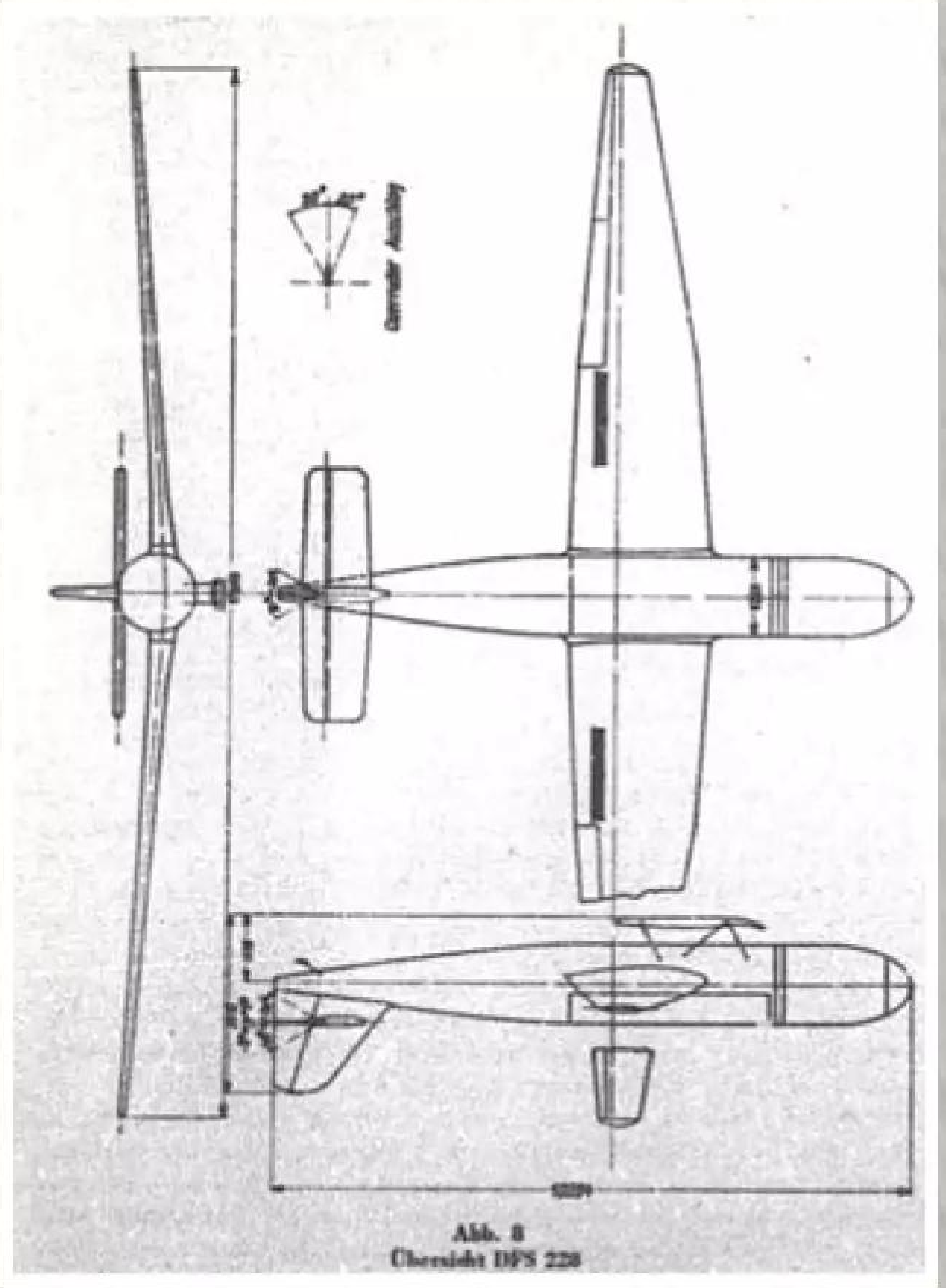


The DFS 228 V1, D-IBFQ, as viewed from the side while resting on its landing skid on the back of a low loader.



Rear view of the DFS 228 V1 with its rocket motor, or perhaps a spare rocket motor, positioned behind it on a wooden crate. The aircraft's tailplanes have already suffered heavy damage.



A three-view of the DFS 228 from Felix Kracht's presentation to the DAL in 1944. The 228 was very similar to the earlier DFS 54 – the main difference being the installation of a rocket motor and fuel tanks.

"Development of a high altitude reconnaissance aircraft (DFS 228). The construction proofs for the fuselage were largely carried out and the drawings were completed down to the last detail. Individual assemblies are already in workshop processing."

Four months later, the official DFS progress report for December 1943 says: "Development of a glider for high altitude (DFS 54). Construction was completed. The cabin has been completed, it is currently being tested for strength and tightness. Testing in the altitude chamber of E-Stelle Rechlin will follow. The remaining assemblies are expected to be completed by the end of construction.

"Development of a high altitude reconnaissance aircraft (DFS 228). The supporting and tail units are under construction and will be completed by mid-January. Fuselage, fuel system, engine installation are currently in work. If there are no new difficulties, the V1 will be ready to fly at the beginning of March."

The progress report for March 1944 makes no mention of the DFS 54, only including an entry for the 'high altitude reconnaissance aircraft' which says: "The construction is complete. Wings, tail and fuselage are completed and are currently being assembled; also the cabin with seat carrier and equipment. Delays occurred as a result of procurement difficulties. The aircraft should be ready for flight during the month of May 1944."

Supersonics

But while the pressure cabin tests would have been useful for gliding research, why continue with the programme when the war situation was already going from bad to worse? The June 18, 1945, report next outlines the DFS 228's purpose as part of a wider programme of research into supersonic speeds: "With the increase of flying speeds and their approach to the speed of sound, the question of the flight-mechanical behaviour at high Mach numbers grew steadily more important, especially for the reaching and passing beyond the speed of sound. The evaluation of the available wind tunnel measurements on sub- and supersonic speeds indicated, that the exceeding of the speed of sound is possible as far as performance is concerned with rocket engines, available in Germany, in high altitudes above 20km.

"The execution of these experiments appears especially important to the Luftfahrtforschung (office of air research), because experiments with high Mach numbers above M = 1.1 are not possible in the wind tunnel; and because the influence of the pressure thrust on the flight-mechanical behaviour can be clarified only in free flight. Carrying out the flight in high altitudes has the further advantage, that the stress becomes considerably smaller than on the ground; as the dynamic pressure in the vicinity of the speed of sound, is only about 4% in altitude, of what the pressure would be on the ground.

"Apart from this, the flight in this altitude brings a number of difficulties; especially the air supply for the pressurised cabin. Further, the possibility to use rocket engines in these altitudes remains to be cleared up, and provisions for the rescue of the pilot in case of emergency have to be provided. independent of that, all possibilities are to be examined, which are apt to move the critical Mach number into the sphere of higher speeds; and to reduce the increased resistance when the speed of sound is exceeded. The greatest gain in this respect is promised by the swept-back wing, but no exact data are available on the optimal sweep back."

In essence, it was thought that four elements were necessary for a supersonic aircraft on which crucial research data was missing: a pressure cabin, a means of pilot escape, rocket motors and swept wings.

The report goes on: "All these problems could not be solved in a single test flight, therefore the DFS proposed a step-by-step solution in three sections. The first section comprises the development and testing of the pressurised cabin and the rescue possibilities for the pilot, in case of emergency. Furthermore, it includes the testing of the engines and the engine installation in great altitudes.

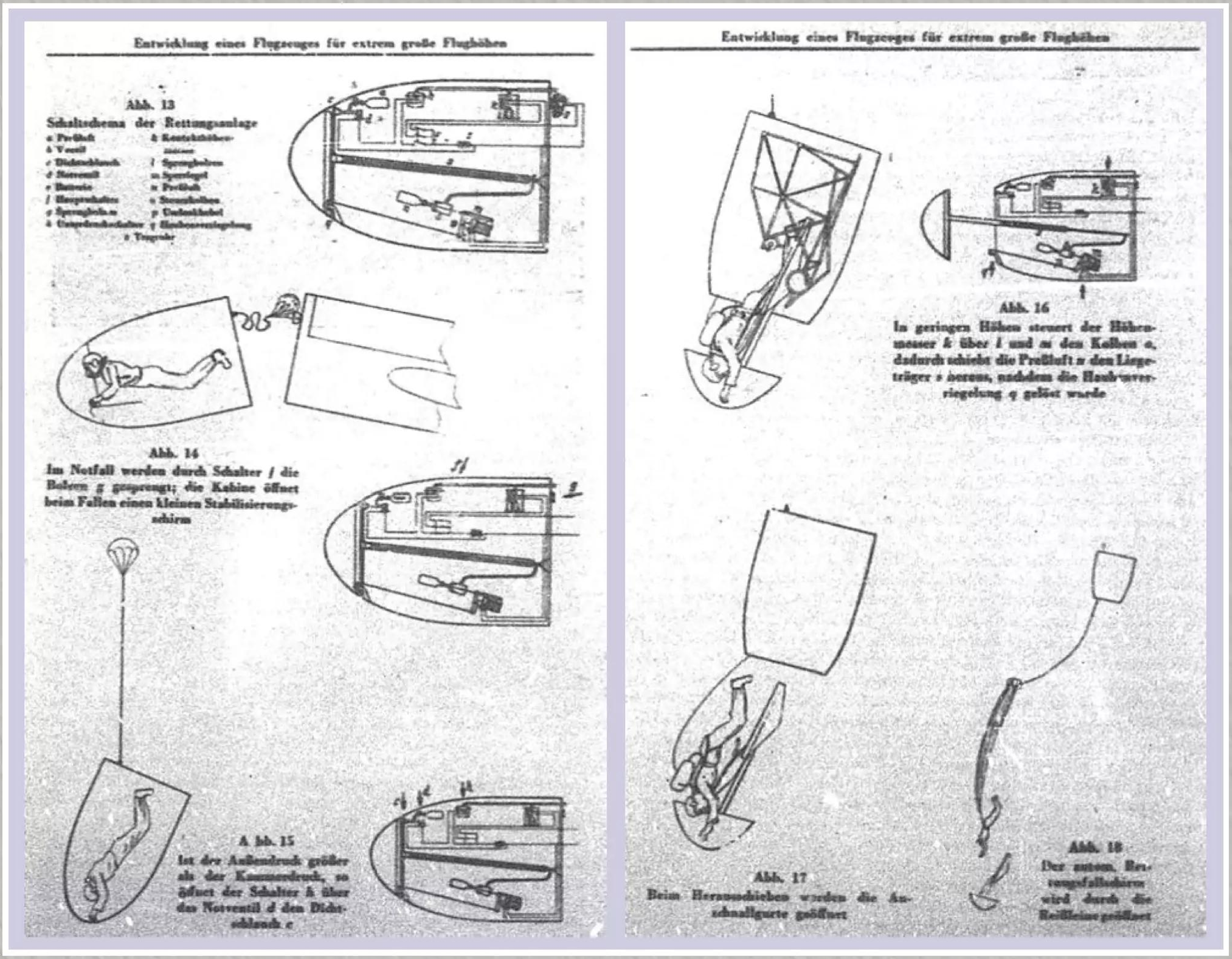
"The second section should determine the best angle of sweep back at which the critical Mach number can be moved back as far as possible, and at the angle the resistance increases when exceeding the speed of sound. Simultaneously this section should determine the flight-mechanical behaviour of swept back wings under high subsonic speeds; especially also in the range of high lifting coefficients, as well as on the efficiency of landing-aid devices. Finally in the third section, it was planned to develop an actual aircraft for flights at and above the speed of sound.

"The first section calls for a test carrier for great altitudes. For this purpose, the DFS designed the model DFS 228 which, intentionally, was limited to relatively low Mach numbers (M = 0.75) and to subsonic speeds. On the basis of the submitted data, the RLM was required to construct the aircraft in such a manner that it could be employed for short range reconnaissance purposes at great altitudes over especially dangerous areas."

It would appear that although the DFS 228 was intended as a test aircraft for pressure cabins and rocket engines, the RLM could only get approval to build it on the basis that it would also be able to perform a militarily useful role high altitude reconnaissance.

"The flying distance asked for and the fuel capacity required for this, made this task more difficult. However, the aircraft in its present form can still be used for its original purpose. The design was intended for a ceiling of about 25km. The first two prototypes have been completed. Practical experiences with the first model indicated the necessity to modify the pressurised cabin, because the visibility was not sufficient and the emergency escape installation as well as the sealing of the cabin created considerable difficulties, because of the great surfaces involved.

"For this reason the position of the pilot in the second model was chosen to be a prone position, which permits these problems to be solved easily. A part of this cabin could be secured in comparatively good condition in Hörsching. All constructional data are at hand. The wing assemblies and the control assemblies ➤



Entwicklung eines Flugzeuges für extrem große Flughöhen

Abb. 13

Schaltschema der Rettungsanlage

a Preßluft	k Kontakthöhenmesser
b Ventil	l Sprengbolzen
c Dichtschlauch	m Sperrkegel
d Notventil	n Preßluft
e Batterie	o Steuerkolben
f Hauptschalter	p Umlenkhebel
g Sprengbolzen	q Haubenverriegelung
h Unterdruckschalter	s Tragrohr

Abb. 14

Im Notfall werden durch Schalter f die Bolzen g gesprengt; die Kabine öffnet beim Fallen einen kleinen Stabilisierungsschirm

A bb. 15

Ist der Außendruck größer als der Kammerdruck, so öffnet der Schalter h über das Notventil d den Dichtschlauch c

Entwicklung eines Flugzeuges für extrem große Flughöhen

Abb. 16

In geringen Höhen steuert der Höhenmesser k über l und m den Kolben o, dadurch schiebt die Preßluft n den Liegeträger s heraus, nachdem die Haubenverriegelung q gelöst wurde

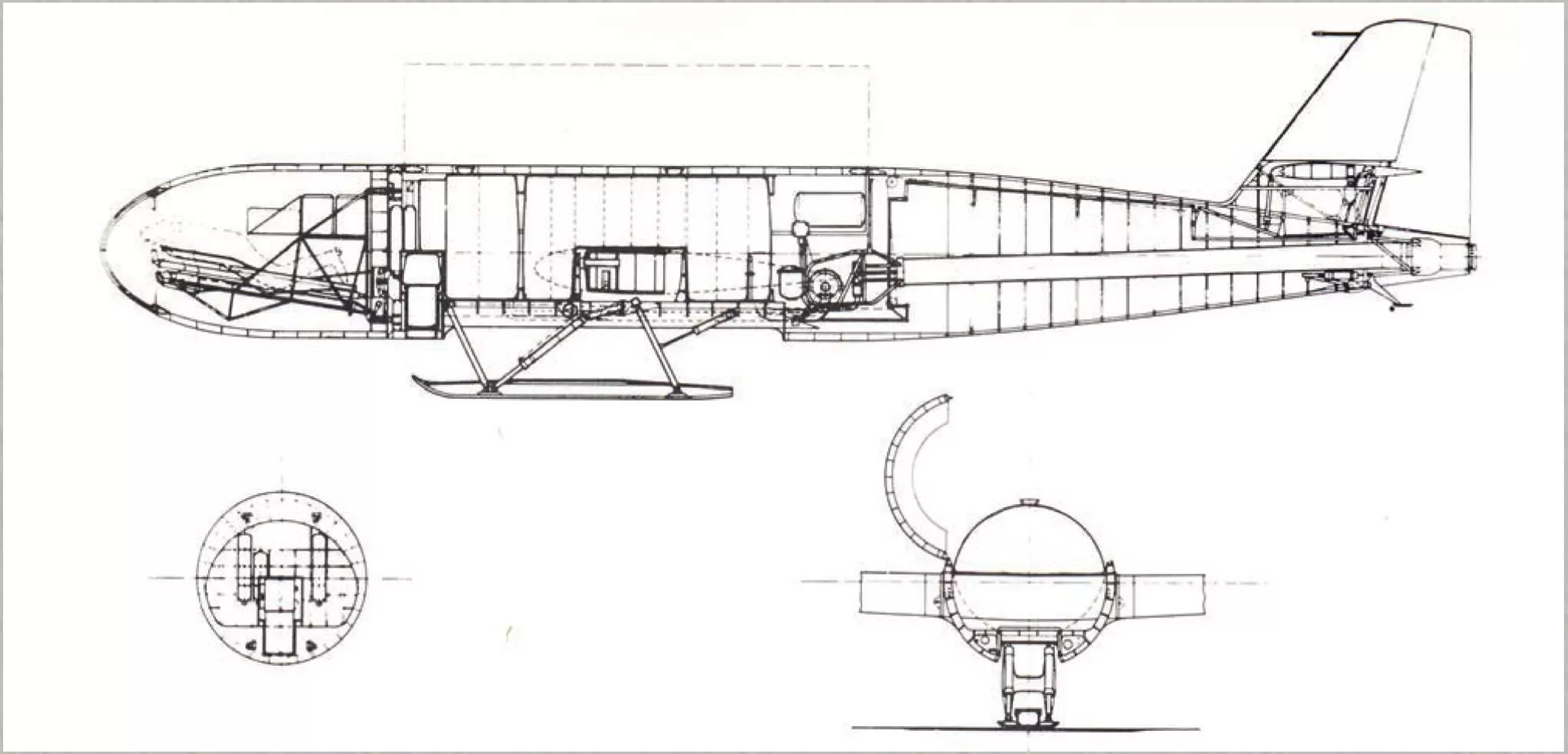
Abb. 17

Beim Herausschieben werden die Anschnallgurte geöffnet

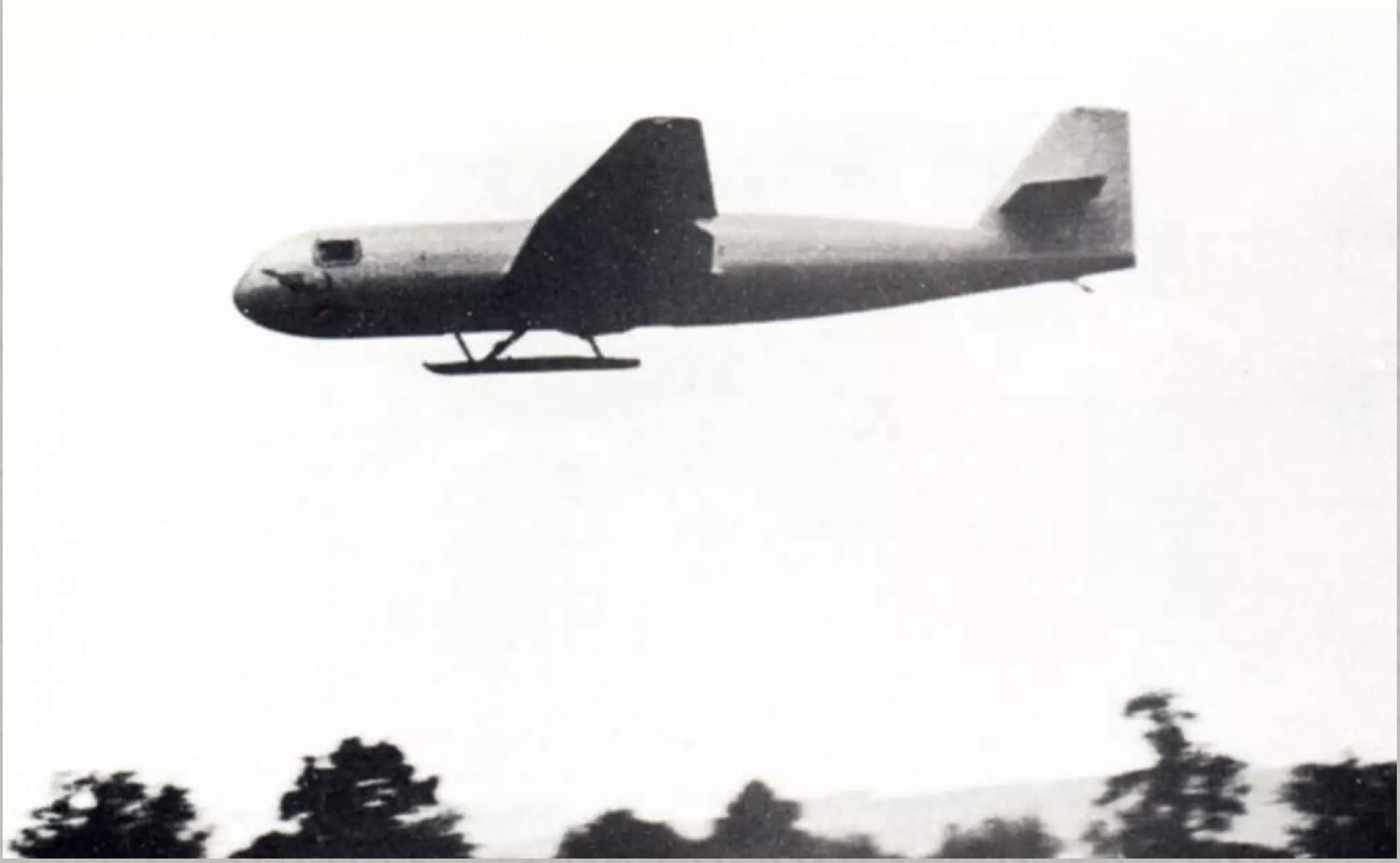
Abb. 18

Der autom. Rettungsfallschirm wird durch die Reißleine geöffnet

Diagrams showing the innovative escape system developed for the DFS 228 V2. The V2 was mostly destroyed before it could be completed.



Side view of the DFS 228 V2 with prone pilot cockpit from Kracht's 1944 presentation. No original drawing is known to exist today showing the V1's seated configuration.



The DFS 228 V1 coming in to land. The distinctive ‘swordfish’ graphic painted on the aircraft’s port side is just visible.

for both examples were manufactured by the Schmetz firm, Herzogenrath. The fuselages and the cabins were constructed by the DFS. The Wrede firm in Freilassing, who were supposed to have built two further aircraft, did not get started with this work.”

British intelligence report A.I.2(g) No. 2/46, on the DFS 228, offers a few more insights on the aircraft and its design: “Performance. Since DFS had built up a greater experience of gliders than any similar institution in the world it was not unnatural that the 228 photo recce aircraft was developed from a glider. The Walter rocket unit is particularly adaptable for powering aircraft of this type since the dry weight of the power installation is only 368lb, thus the gliding weight of the aircraft is low and a wing loading of 15.5lb/sq ft at 75,000ft and 9.4lb/sq ft at 39,400ft permit the extensive glides which make possible the range of 650 miles.

“The maximum speed of 560mph at sea level and 435mph at 75,000ft is limited by the critical Mach number of .66. Since the stalling speed of the aircraft is estimated as being below 500mph it is possible to reach a height of 84,000ft before critical Mach number and stalling speed coincide. Handling of the aircraft would be extremely difficult if not impossible at or near this critical height so the operational height was reduced to 75,000ft.

“In the 228 V1 the pilot sat in the normal flying attitude with resultant poor visibility. The 228 V2 was to have had a prone position, the pilot then having his head close to the single forward window which gave much improved forward vision.

“Conclusion. The aerodynamic characteristics of this aircraft are of less importance than the design of the pressure cabin. A speed of 435mph claimed at 70,000ft is not great, this being only .66 Mach. High thrust, irrespective of height, makes possible the high rate of climb and the modest wing loading when most of the fuel is used up makes possible the extensive gliding which extends the total range of the aircraft to 650 miles with a full power endurance of only four and a half minutes.

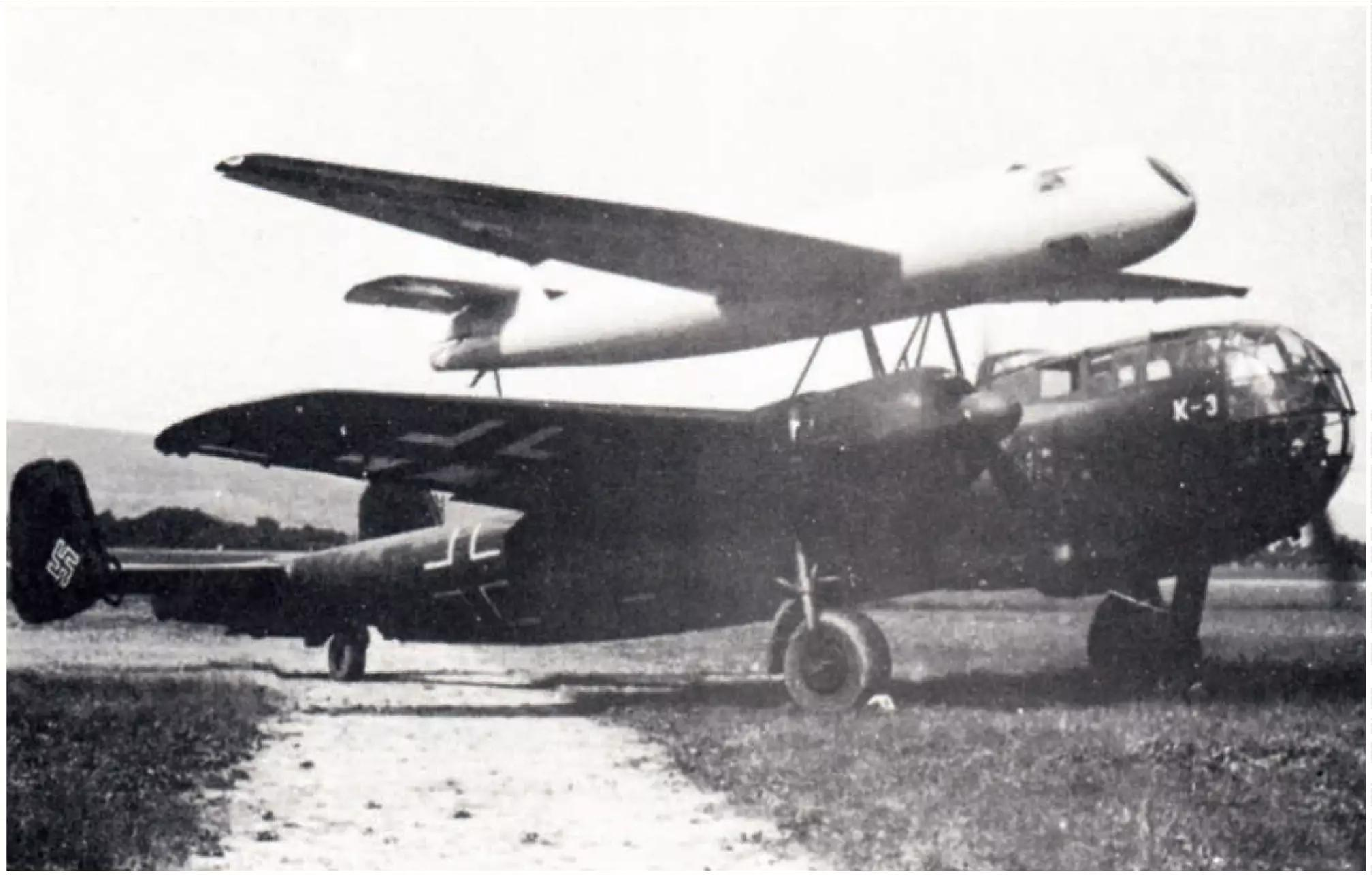
“It is on the reliable operation of the pressure cabin that the success of the aircraft depends. Sudden and absolute failure of pressure at 75,000ft would mean the instant death of the pilot. To build a cabin of light construction that was, at the same time, thoroughly dependable involved a departure from the established practice in pressure cabin design.

“Should it become necessary to abandon the aircraft the pilot must remain within his pressure cabin until a safe altitude is reached at which he could live without additional oxygen. Thus the pressure cabin was to have been jettisoned and the pilot later ejected from the cabin. Planning and design were sound, the difficulties had been faced in a practical manner and although simplification resulted in some discomfort to the pilot this cannot be regarded as serious in view of the short flying time of the aircraft.

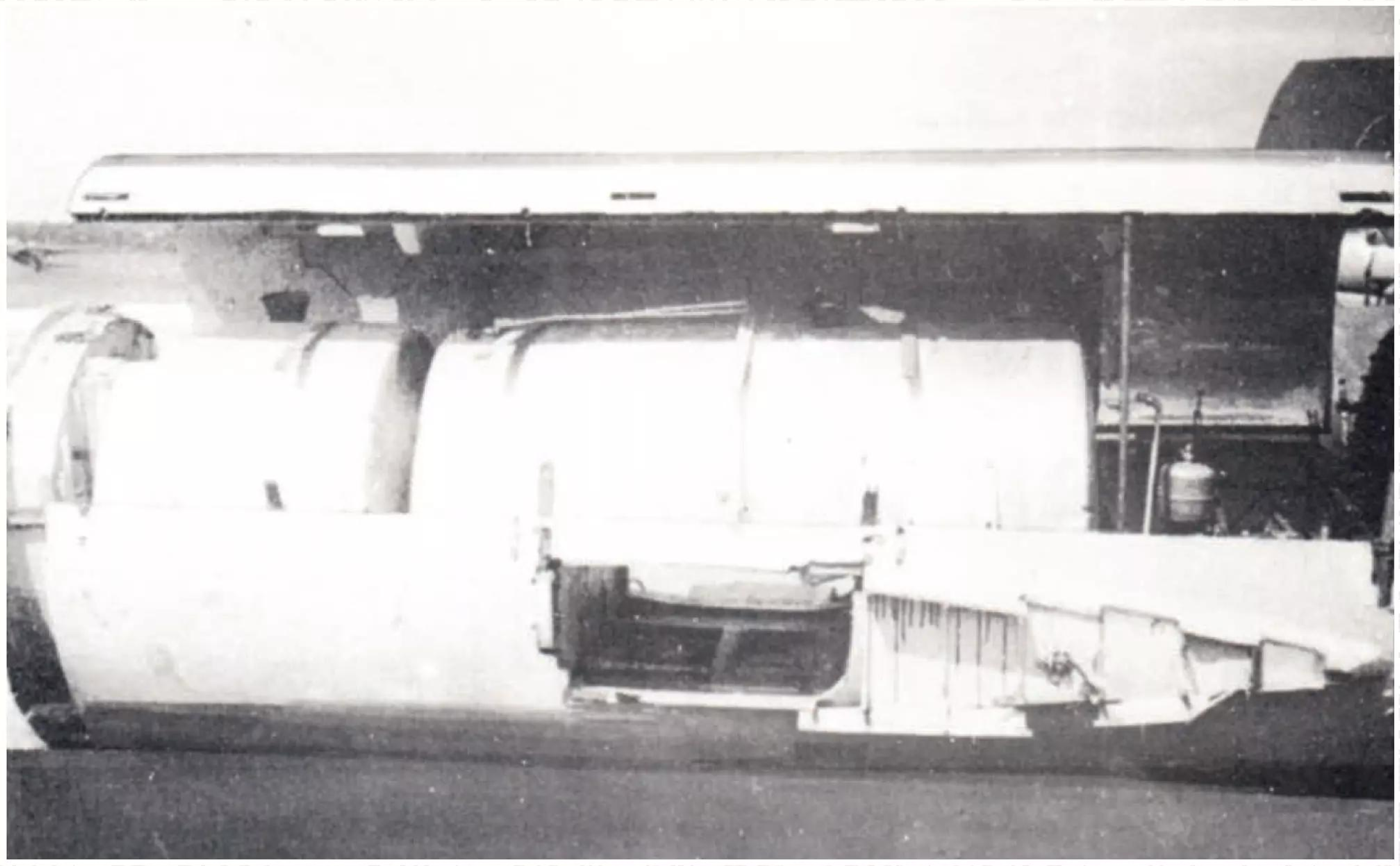
“Nevertheless, the enormity of the problem of reliable pressurisation, when sudden failure has such dire results, cannot be ignored. The DFS 228 is magnificent in conception, but it had travelled only about a third of the way towards its final development.”

DFS P 1068s

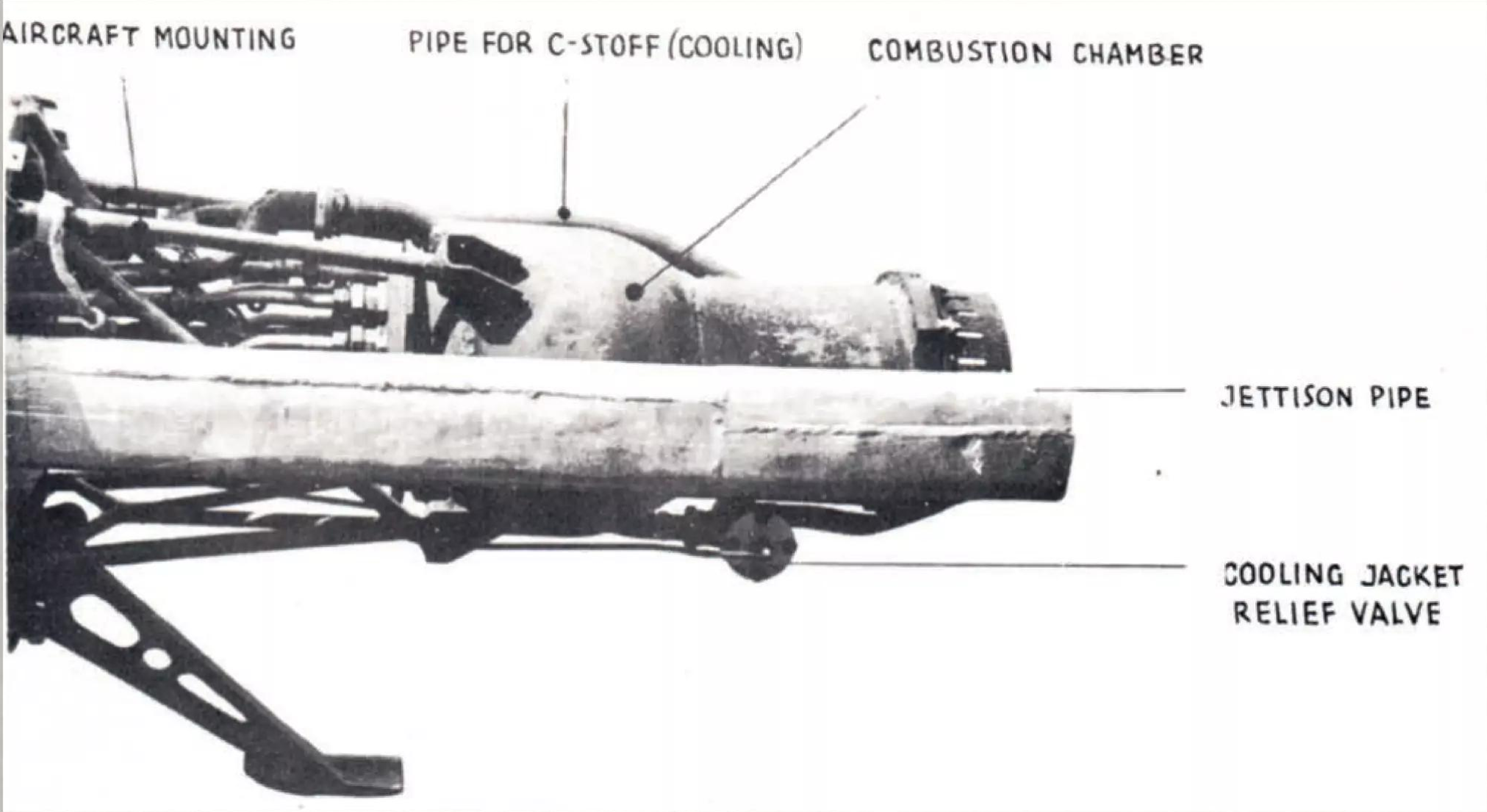
Returning to the ‘second section’ of research on developments necessary for supersonic flight, the June 18, 1945, report says: “The second section should be solved by the building of the series of P 1068. The following versions were planned: P 1068 with 25° sweep back angle, P 1068 A with 35° sweep back angle, P 1068 B with 0° sweep back angle and additional propulsion, P 1068 C with 35° sweep back angle and additional ➤



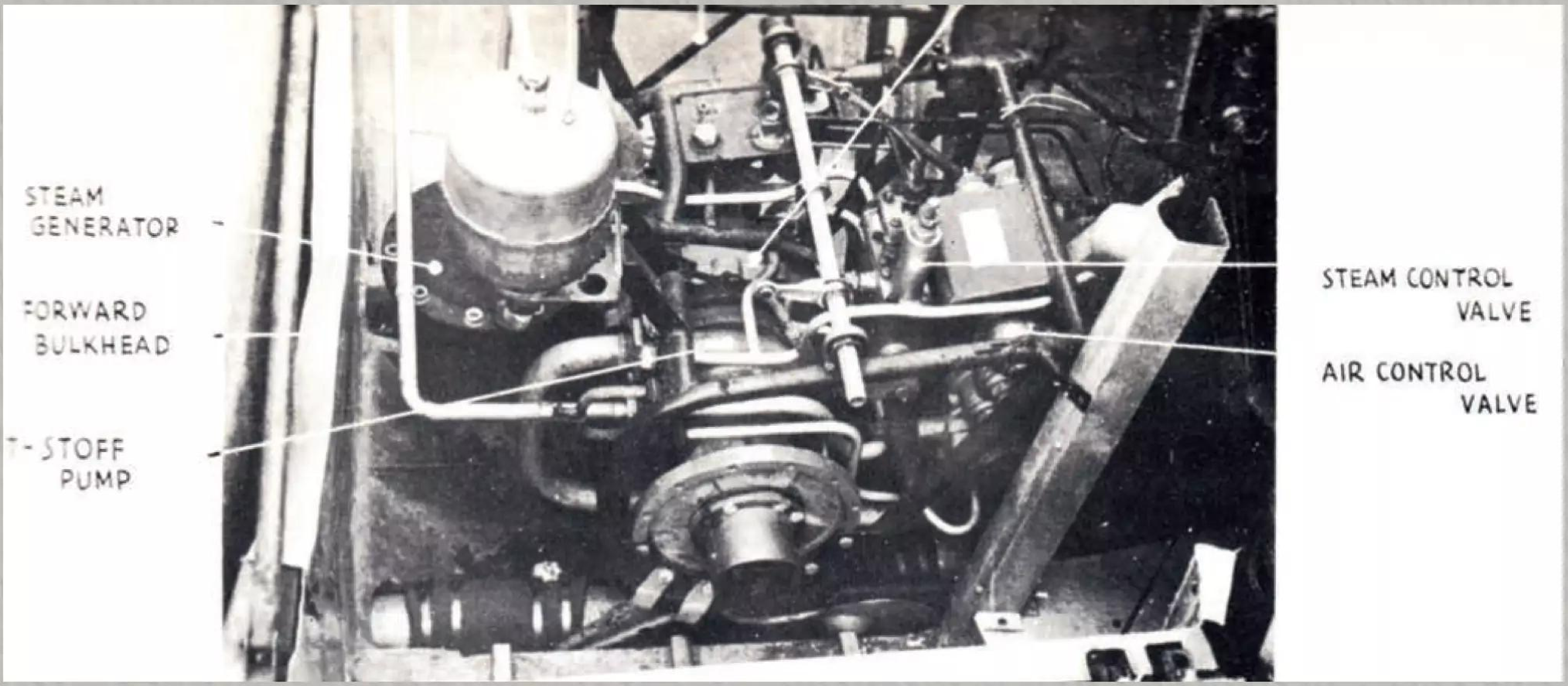
Rather than being towed aloft, the DFS 228 was launched from the back of a Dornier Do 217 K – only activating its rocket engine at the appropriate altitude.



Port view of the DFS 228's fuselage with access hatch open and the aircraft's rocket fuel tanks visible. The central tank was for oxidiser T-Stoff (high-test peroxide) while the tank to the left was for C-Stoff – the fuel itself. The ratio of T-Stoff used to C-Stoff was 3:1.


AIRCRAFT MOUNTING
PIPE FOR C-STOFF (COOLING)
COMBUSTION CHAMBER
JETTISON PIPE
COOLING JACKET RELIEF VALVE

Rear section of the DFS 228's propulsion unit showing combustion chamber and fuel jettison pipe.


STEAM GENERATOR
FORWARD BULKHEAD
T-STOFF PUMP
STEAM CONTROL VALVE
AIR CONTROL VALVE

The DFS 228's Walter rocket motor.

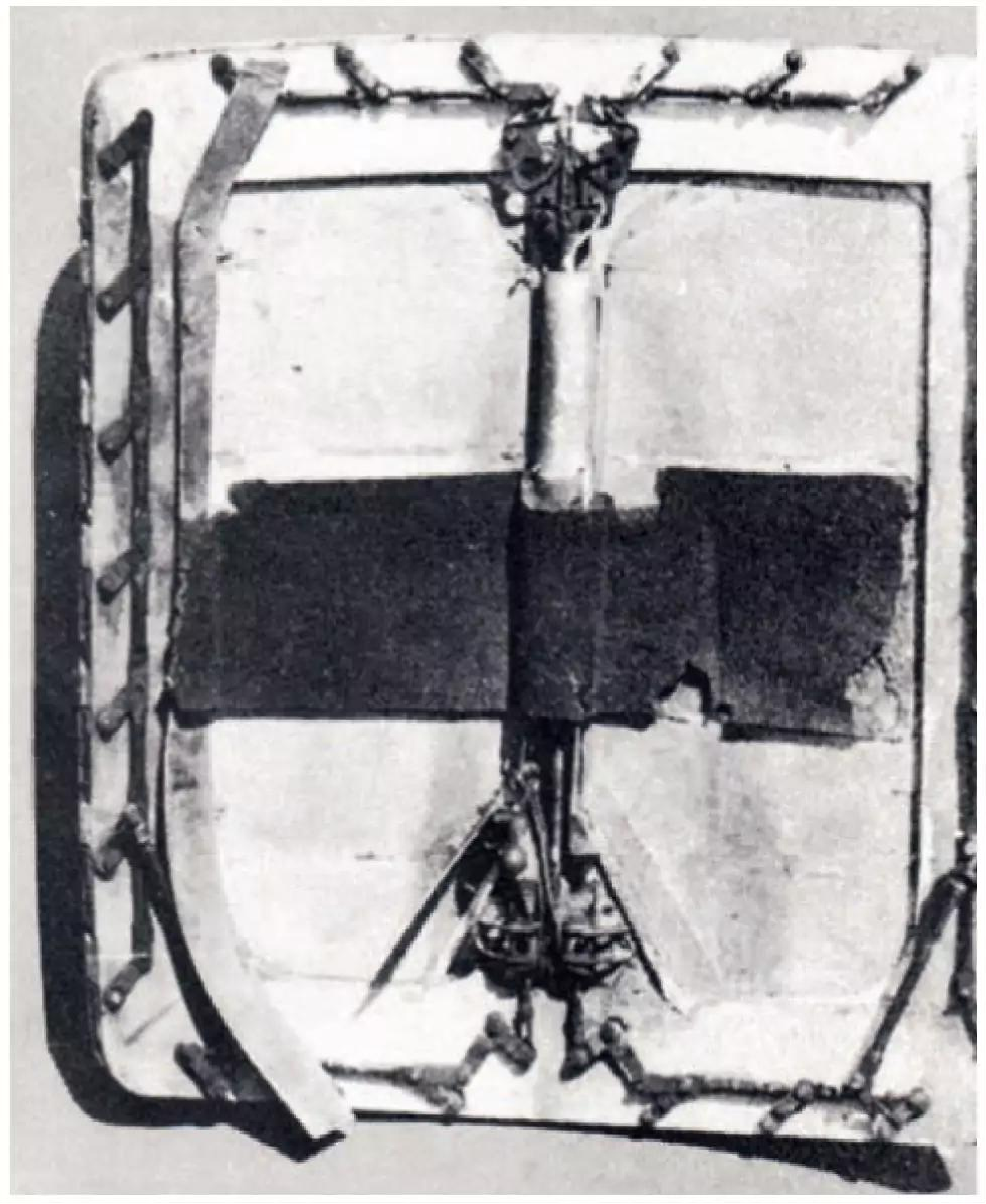
propulsion, P 1068 D with 35° sweep back angle and laminar wings.

"As landing equipment, all models were furnished with slots and fowler flaps, except that the P 1068 D was to be equipped with leading edge split flaps instead of the standard slots. In all models, engine nacelle and cowling could be built in for the TL propelling units Jumo 004 or HeS 11. The Wrede firm in Freilassing did the construction work.

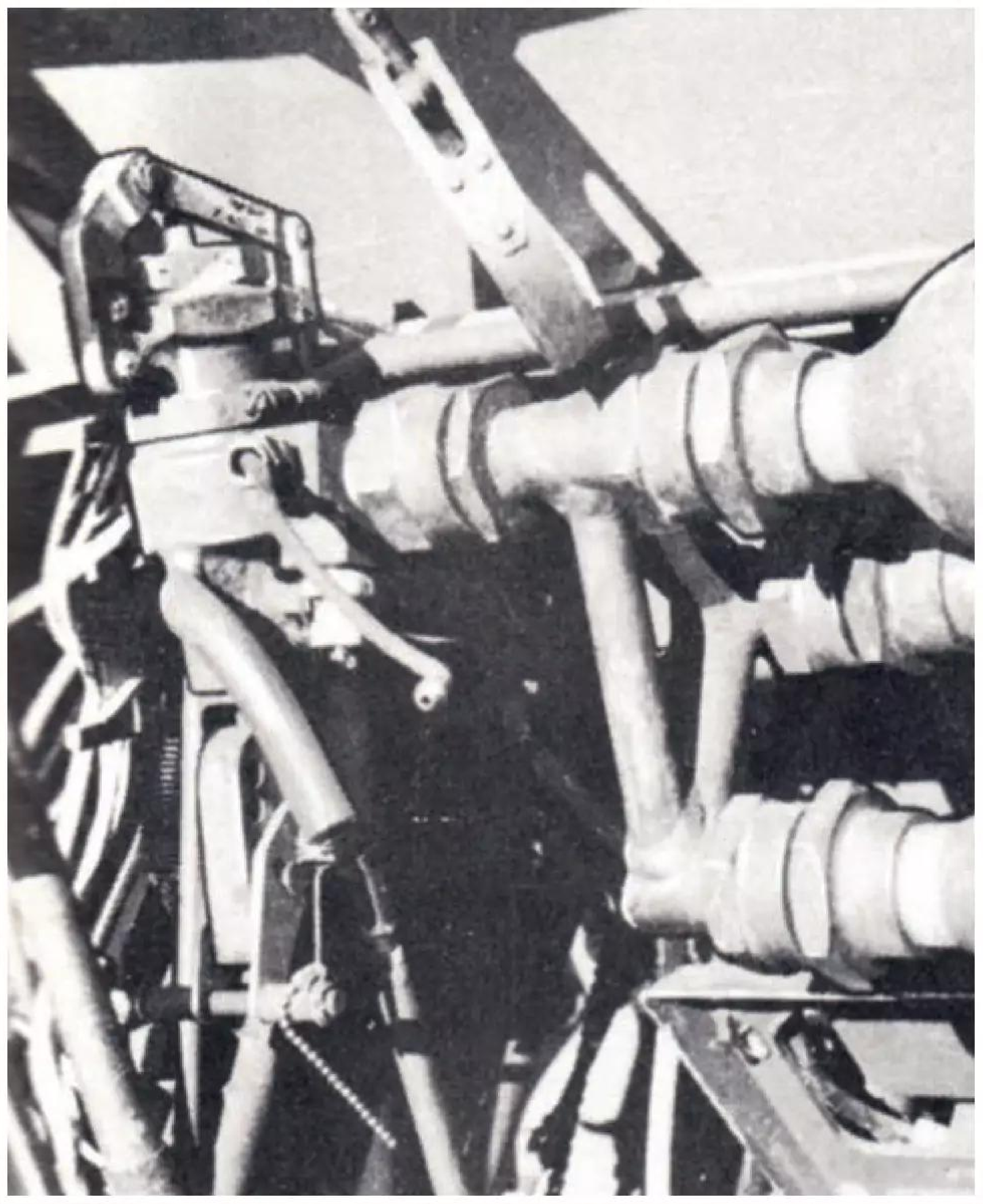
"The first model survived undamaged and was removed recently from Ainring by American military authorities. Its present location is unknown. The second model was destroyed in the beginning of May in Hörsching. Approximately 40 take-offs were carried out with the first model and flight characteristics of the aircraft body were tested without engines. Then ground tests of the engines and fuel installation were completed. However, due to the flying prohibition flight tests with the engines could not be carried out.

"The data for the construction of the P 1068, P 1068 A and P 1068 B, as well as to a great extent, the data for the model P 1068 D, and also a series of static tests were still necessary to complete the P 1068 C, before the construction of the wings could be started. The construction of all models was planned to be carried out by the Wrede firm in Freilassing. The DFS was limited to supply single complicated parts, and to install the electric and measuring equipment. The P 1068 was almost finished. The model P 1068 A was completed about 40 to 50%.

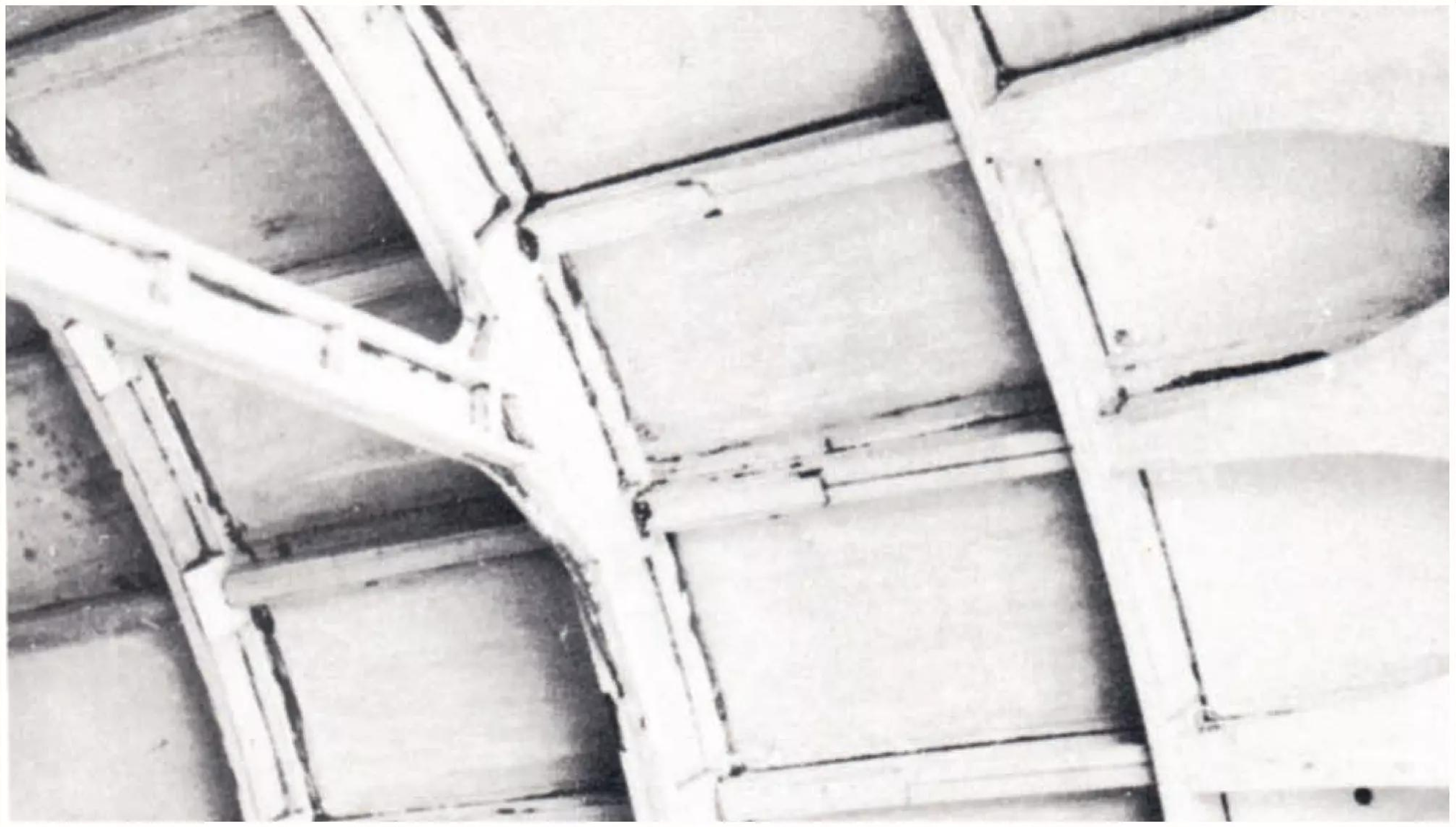
"Construction of parts for the P 1068 C had been started. All parts, as well ➤



Cockpit hatch of the DFS 228 as viewed from the underside.



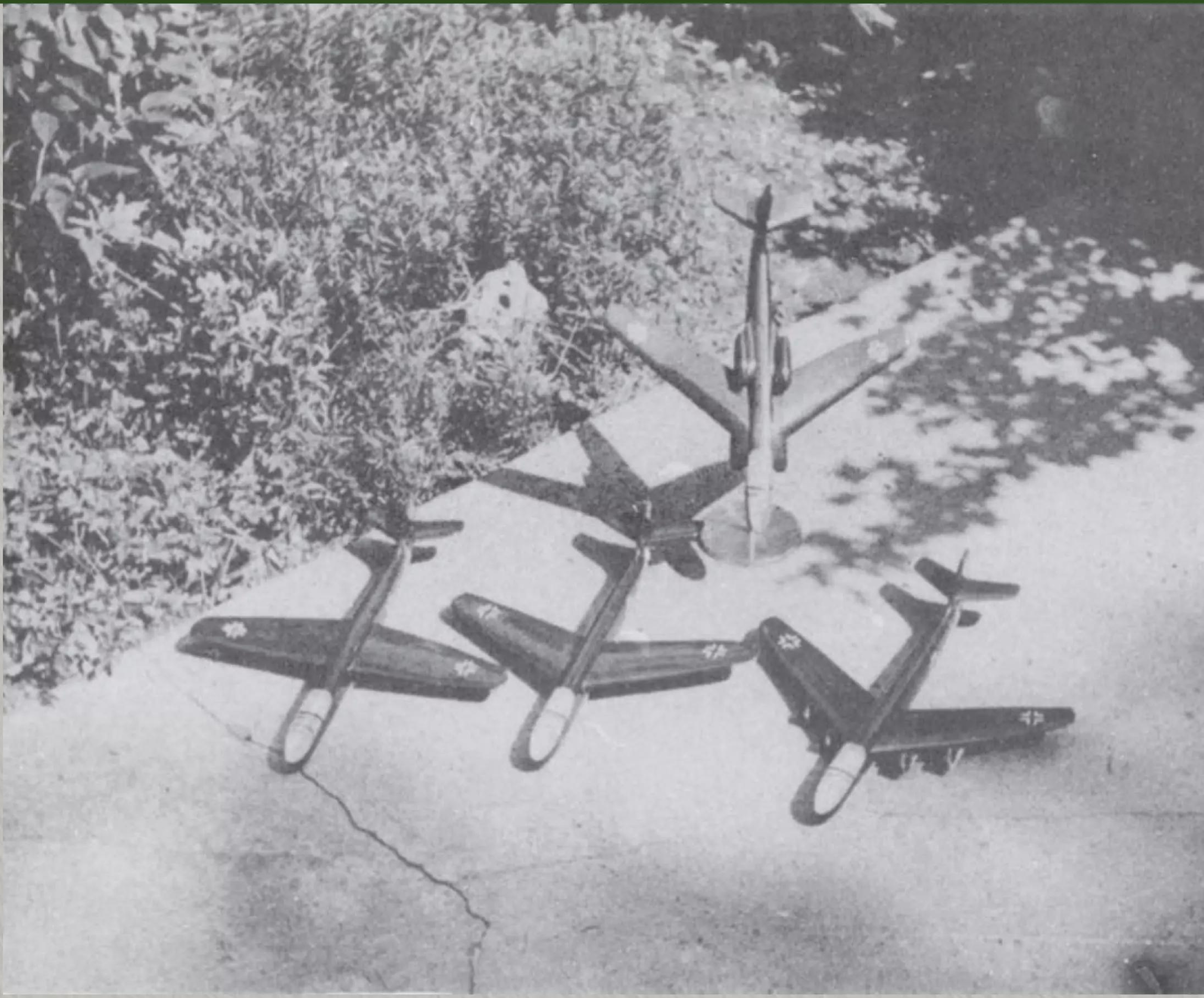
Emergency ejection valve of the DFS 228.



DFS 228 rear fuselage construction as seen from the inside.

as a small amount of construction data, were completely destroyed by the fire at the Wrede firm."

An interrogation of Walter Georgii on June 10, 1945, reported in Allied CIOS report XXXII-66 Deutsche Forschungsanstalt für Segelflug, Ainring, clarifies just what the DFS P 1068s were: "The 1068 is a series of four aircraft identical except for the angle of sweep-back which was 0, 25, 35 and 45 degrees respectively; the purpose is to check aerodynamic calculations on the effect of sweep-back exchangeable mid-section of wing mounted in such a way that its angle of incidence can be changed during flight



Four display models of the DFS P 1068. Each has the same fuselage but a different wing sweepback angle, going from 0˚ on the model to the bottom left to 25˚, centre bottom, 35˚ on the bottom right model and finally 45˚ on the model that is fixed to a display stand. Exactly what the full-scale DFS P 1068 looked like is unknown – but sources confirm that it was built.

and so that lift, drag and moment can be measured accurately, the purpose is to test high performance air foils at high Reynolds numbers in turbulence-free air.

"The four models of the 1068 [Georgii appears to have missed out the P 1068 D referred to in the other report] were completely designed; drawings are available. The 25˚ sweep-back model was almost completed and the 35˚ model was partially constructed at the firm Wrede at Freilassing. They were completely destroyed in a recent raid.

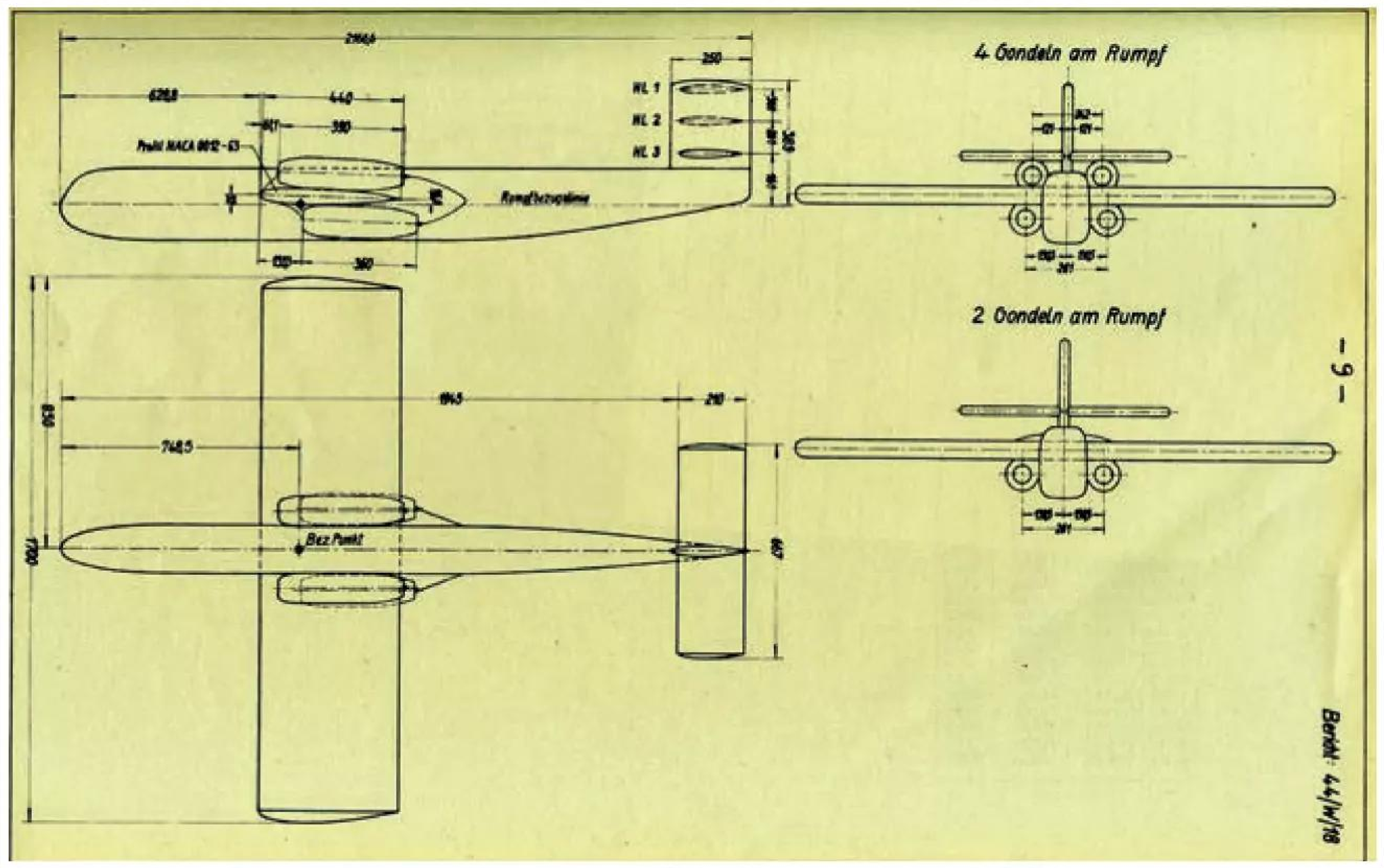
"All four were to be equipped with mountings for four power unit nacelles, whether on the wings or on the fuselage. Either the Ju 004 or the HeS 011 could be used. In addition, the 0, 35, and 45 models were to have a Walter rocket propulsion unit of 1500kg thrust in order to get excess speed."

The first report states that about 40 take-offs were carried out with the completed but unpowered 25˚ swept P 1068 model, while Georgii states that it was never completed. It is possible Georgii regarded the aircraft as incomplete because it was never equipped with its turbojets.

In any case, the minutes of a meeting held at the FoFü in Berlin on July 18, 1944 suggest that none of the P 1068s were originally intended to include rocket propulsion. Among those in attendance were Walter Georgii, Kracht and Ruden from the DFS, Hans Multhopp from Focke-Wulf, Scheibe and Oberingenieur Malz from the RLM's GL/C-E 2, Adolf Busemann from the LFA, and two representatives from Heinkel – Motzfeld and Eichler.

The minutes state: "For the airspeed range, in which Mach-influences are not decisive, a manned example of the model P 1068 with Walter drive is to be built. The aim of this model is to measure wing moments and polar. The construction was completed, according to Mr Kracht, in 7-8 weeks. The change of the construction for the above mentioned task will take about 2 months. For the metalwork, the department E 2 will try to free the company Siebel. The reception of the E-Stelle Travemünde for such work is under investigation.

"For woodwork the companies Focke-Wulf and Junkers, the production ➤



Drawing of a P 1068 wind tunnel model tested by the AVA. The test results were reported in a document dated July 20, 1944. The report makes it clear that the P 1068's wings and tail would not have looked like this – the designs were simplified for the test model because only the positioning of the engines was important.

groups Silesia and Poznan are to be consulted with the help of the special committee F4. The purpose is to investigate the flight behaviour of low-velocity and high-speed swept wing aircraft and perform profile and roughness surveys. The profile is released by the wind tunnel committee in cooperation with DFS. For the measurement purposes, a drive duration of 100 seconds is sufficient.

"The Committee for Aircraft Mechanics will be available to advise on the installation of measuring instruments. The amount of construction hours, wood and metal work is put together and the research management announced."

On July 20, 1944, the AVA produced a report entitled 'Stability measurements on the Heinkel overall model P 1068 with special engines'. This state: "Overview: Three- and six-component measurements were made on the overall model P 1068 from Heinkel. In these measurements, special engines were installed partly on the fuselage and partly on the wing. The engines were equipped with electric motors and fans, so that they could be measured without and with exhaust."

The wind tunnel tests carried out by the AVA were intended to determine the effects on stability of attaching the engine nacelles directly to the fuselage, compared to their effect on stability when fitted to the wings. Under model description, the report states: "The planned investigations are for the clarification of fundamental questions. It therefore seemed necessary to eliminate all parameters which were not absolutely necessary during the measurement.

"For this reason, and to speed up the production of the model, a rectangular wing with a symmetrical profile was provided instead of the swept form designed for the full-scale wing, and a rectangular tailplane was used instead of the swept tailplane. The vertical stabilizer was also rectangular, while the fuselage was modelled to be geometrically similar to that of the full-scale version (P 1068)."

Presumably these tests relate to the DFS P 1068, since Georgii states that each of the four versions was to have turbojet attachment points on its fuselage.

The minutes of a meeting of the Entwicklungshauptkommission on November 21-22, 1944, under the heading 'research aircraft' state that: "Work on the '1068' piloted flying model with rocket propulsion was to continue as planned."

And the war diary of the Chef TLR, for the period of January 15 to January 21, 1945, says: "After examining the company Wrede-Freilassing, the execution of the order is possible there in addition to the already starting production 1068." But the following week it says: "Study aircraft 1068: FoFü reports that it is unlikely that DFS will be able to build the 35° swept winged area. As requested by Heinkel this wing is to be regarded as a further development of the 162 wing, construction is absolutely necessary. Fa. Wrede cannot take over construction."

The P 1068 does not appear on a status report concerning the 'Entwicklungs-Notprogramm' dated circa February 27, 1945, however, suggesting that the project had been abandoned by this point. What does appear on the status report, however, is the 8-346 aka DFS 346.

DFS 346

Regarding the third and final stage of research on developments necessary for supersonic flight, the June 18, 1945, report says: "Based on the above considerations for the third section of this research programme, the DFS developed an aircraft which appeared capable of solving the flight mechanical problems of supersonic speeds. As the institute for aircraft construction was fully occupied with the DFS 228 and P 1068, and in as much as the development of this supersonic aircraft was to be stepped up as fast as possible, the chief research office and the RLM agreed that the DFS would be the chief research office and the RLM agreed that the DFS would be in charge only as far as the project control was concerned; and that the construction and building would be given to a capable firm of the aviation industry.

"For this purpose the Siebel-Flugzeugbau in Halle was later engaged. All project data, which had been worked out by the DFS survived undamaged. They were sent to the Siebel firm in November 1944, but in March 1945 the construction work on this model did not exceed basic fundamentals. Wind tunnel measurements necessary for the determination of load distribution were carried out in the wind tunnel of the DFS in Darmstadt. A model is being worked on for measurements in the high speed wind tunnel of the DVL in Berlin."

Work on the DFS 346 – the actual supersonic research aircraft itself – appears to have begun relatively late. On May 31, 1944, the RLM's Oberingenieur Malz had sent Messerschmitt, Heinkel, Arado, Focke-Wulf, Siebel and Blohm & Voss, with the DFS and the FoFü copied in, a letter headed 'Subject: Problem of fast flight'. It said: "It is intended to build a study aircraft at Siebel Flugzeugbau Halle, which is to be used to investigate the problems occurring during high-speed flight and in the wind tunnel.

"This aircraft, which may also be built in some variants, should be provided with turbojet drive and fuel for an hour of flight time. The crew shall consist of an aircraft pilot and an observer who will operate the extensive measuring equipment required for the purpose of the aircraft.

"It is a distinct research aircraft, so the equipment can be limited to the aircraft and engine monitoring devices as well as radio system for on-board communications and the measuring apparatus. For the safety of the crew, special attention must be paid to the fact that the test programme is inherently risky (ejection seats or cabin with rescue parachute or the like).

"It is requested to draw up a corresponding draft (only project drawings), which covers the knowledge available to you. Suggestions for a high-speed aircraft to be submitted to GL/C-E 2 by July 20, 1944. In a joint discussion with the companies involved, the design of the study aircraft should then be determined. In view of the importance of the task particularly active participation is requested."

In fact, it would appear that the meeting was brought forward two days to July 18 and that this was the same meeting at which it was decided that the DFS P 1068s should be equipped with rocket engines. Evidently Messerschmitt, Heinkel and Arado had all submitted proposals for the design of the high-speed aircraft and these were discussed. In the minutes, after the discussion on the P 1068, 'Point 2' says: "For studies in the high speed range of approximately M = 0.9-0.95, a draft to be implemented is based on the Kosin/Arado proposal. The work will be immediately tackled and completed, according to Mr Kracht, in ten weeks without reinforcement by the Siebel company, or in seven weeks with reinforcement by five men of the Siebel company.

"The developed documents are to be submitted to the Siebel company as demands for construction of such an aircraft. The results of the work will be published and reported to the committee on August 10. As design time at the Siebel company three months is estimated. The cooperation of Siebel will be negotiated.

"Specifically, the project is based on the following structure: general layout of the aircraft is mid-wing with a cylindrical fuselage. The shape of the nose, to reduce drag, is to be clarified by wind tunnel measurements. The final proposal will be assessed in the wind tunnel and subjected to drop tests.

"The wing has 45° sweep angle, chord 1:4, surface load in the final case 100-120kg/m², tapering about 1/3. As control surfaces are provided: a) Rudder with internal compensation – Messerschmitt, b) Split flaps – Göthert DVL, c) Wing end caps – Kosin/Arado.

"As tail units are provided: a) V-tail – Günter/Heinkel, b) High-altitude tail similar to Me 262 – Messerschmitt. For the undercarriage a landing skid is provided. In the construction, two stages of the aircraft are to be considered: For stage 1, an operating height of approx. 10km. It is intended to use the experience gained in the meantime with the DFS 228 pressure cabin for the later test flights in great altitudes. For the final version approx. 25km is assigned as working altitude.

"As drive Walter rocket motors. Provided as emergency control will be a small rocket drive. To be investigated: 1) Properties at velocities of M = 0.9 to 1. 2) Power or drag, 3) Partial drag. 4) Values for load distribution. For 1) and 2) a proposal of the DVL flight department after consultation with the Special Committee for Flight Mechanics. From performance measurements arise the requirements: shear measurement, consumption measurement, acceleration measurement, centre of gravity measurement in flight.

"To 3). The measurement of the wing moment is desired; if possible 3-component measurements of the wing. Partial drag is also measured using engine mock-ups. The mock-ups have a corresponding flow and are attached to the wing or the fuselage. For this, the suggestions should be discussed with Dr. Küchemann/AVA. To 4). Pressure distribution measurements on the structure, fuselage and tail are intended to give information about loads and load distribution."

Based on this evidence, it appears that Arado's high-speed aircraft design became the DFS 346, rather than Siebel itself originating the design.

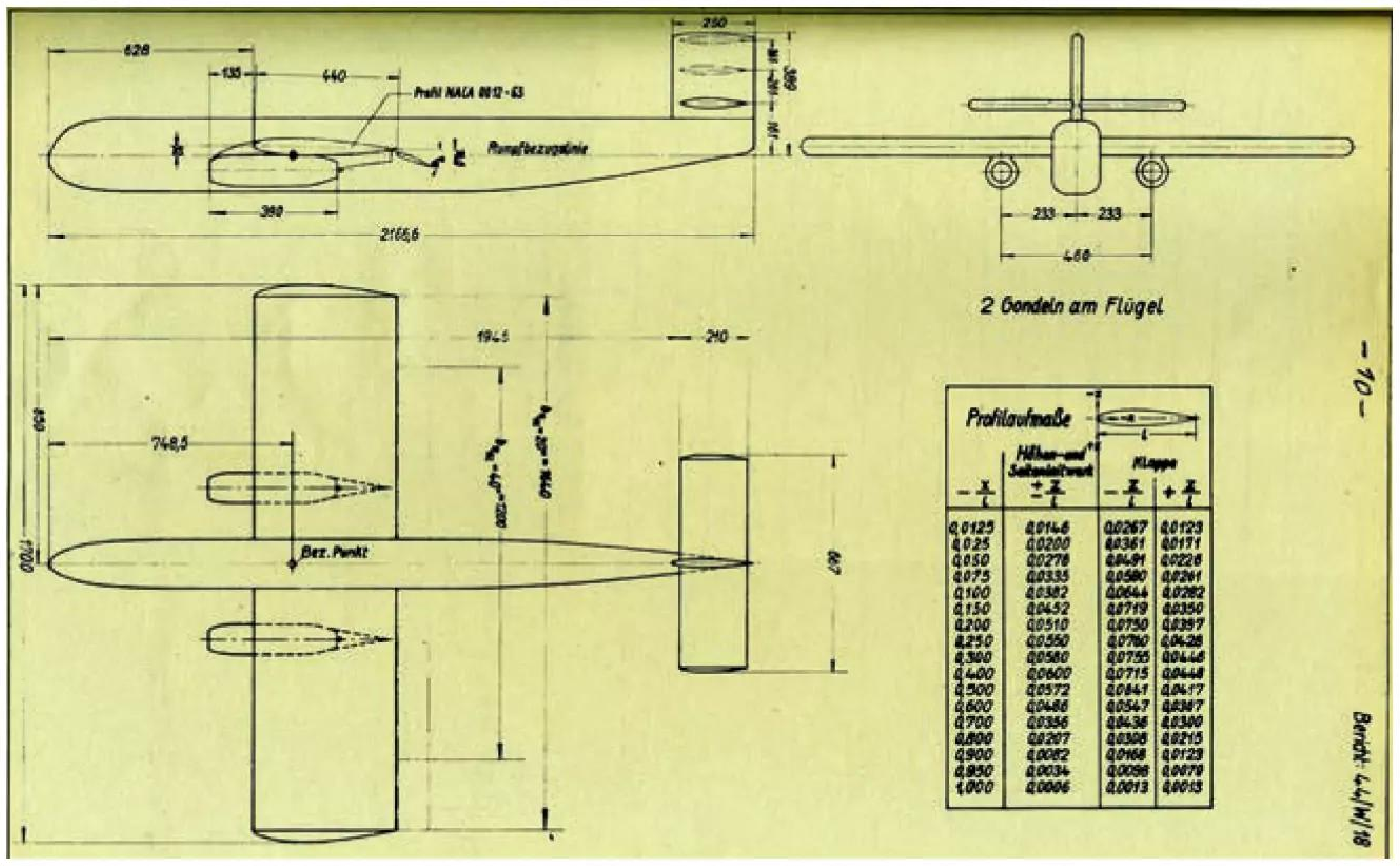
Details of the 8-346 were, as the June 18, 1945, report states, handed over to Siebel at Halle in central eastern Germany for further design and construction work in November 1944. US forces occupied Halle on April 17, 1945, and the following month the technical director of Siebel, Franz Walter, wrote a brief report on the 8-346 for the Americans.

It says: "Purpose. The prototype 8-346 is an airplane with which shall be researched the flying qualities, as there are the stability, the controllability, the manoeuvrability, the values and the distributions of the forces of the directional controls and on the wing and on the tailplanes and all other essential conditions of the flight in the supersonic range and about the most unknown transition point at the velocity of sound. The point where begin the shock waves and therefore the sudden jumping of the centre pressure.

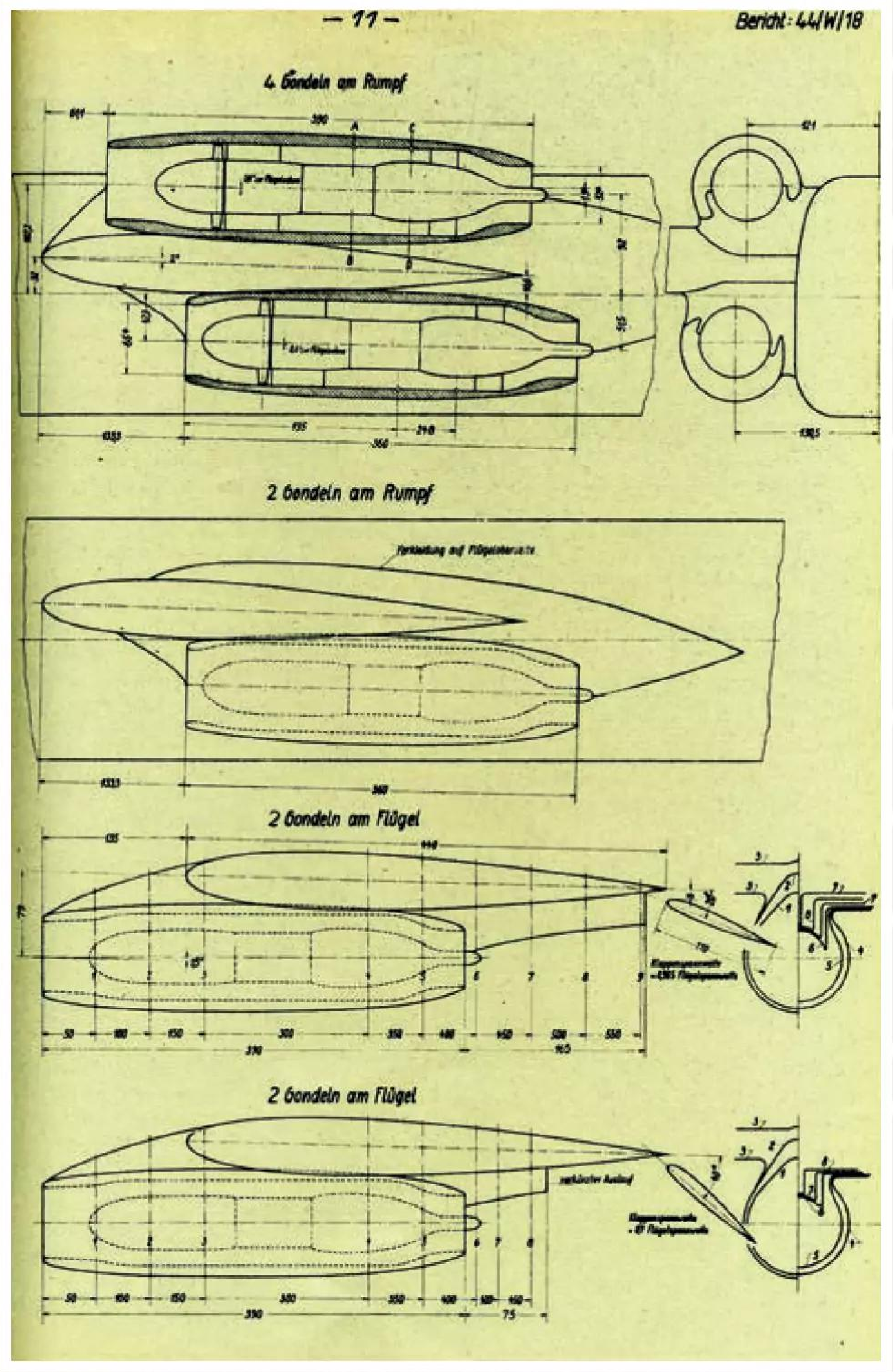
"The aerodynamic qualities of airfoils at very high speeds were determined and by model tests in the wind tunnel and in the free air. But the results did not agree satisfactorily, especially for the travelling of the centre of pressure. In order to research all the unknown conditions and to cover a wide range the airplane was designed for a Mach number of 2 (i.e. for a velocity of V = 2000km/h = 1250mph) and it should be tested as well which different tailplanes and at a variety of Mach numbers.

"The results of all tests would be of very great importance at the design of all super high-speed airplanes and would make it possible to avoid great errors with probable grave consequences.

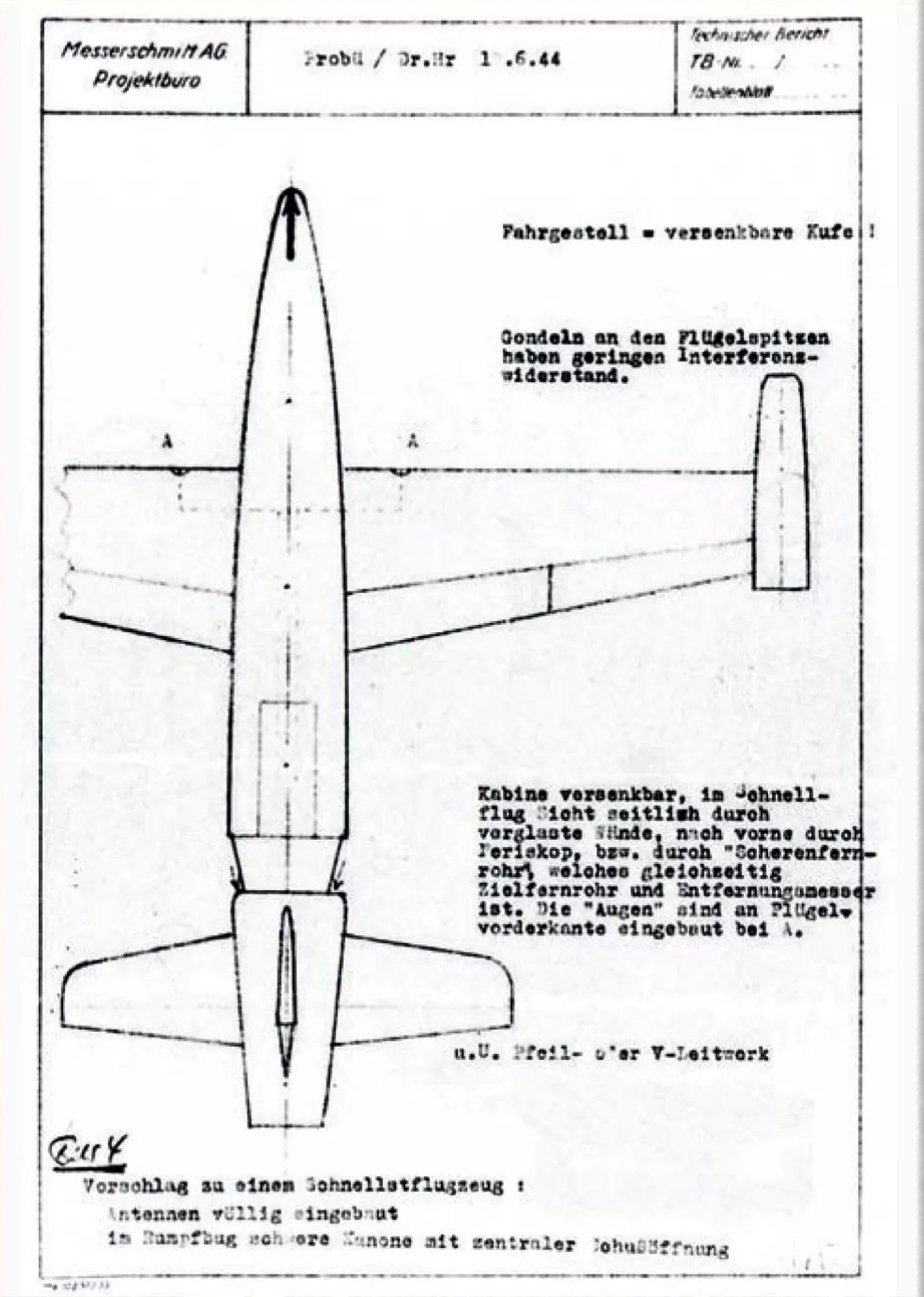
"Description. The airplane is of all metal construction (duralumin) and ➤



The most basic configuration of the P 1068's engines tested by the AVA.



Positioning of the P 1068's engines right against the fuselage was controversial because no test data existed to indicate what effect this might have on the aircraft in flight – hence the AVA tests. Unusually, the model's engine nacelles were fitted with small electrically driven fans to simulate the aircraft's jet exhaust behaviour.



ProbÜ / Dr.Hr 12.6.44

Fahrgestell = versenkbare Kufe !

Gondeln an den Flügelspitzen haben geringen Interferenzwiderstand.

Kabine versenkbar, im Schnellflug Sicht seitlich durch verglaste Wände, nach vorne durch Periskop, bzw. durch "Scherenfernrohr", welches gleichzeitig Zielfernrohr und Entfernungsmesser ist. Die "Augen" sind an Flügelvorderkante eingebaut bei A.

u.U. Pfeil- oder V-Leitwerk

Vorschlag zu einem Schnellstflugzeug :
Antennen völlig eingebaut
im Rumpfbug schwere Kanone mit zentraler Schußöffnung

The Messerschmitt Schnellstflugzeug of June 12, 1944. This would appear to have been Messerschmitt's contender for what would eventually become the DFS 346. A design produced by Arado was chosen instead, becoming the HS-8, which in turn became the DFS 346. The design process was unusually collaborative and also involved input from Arado, Messerschmitt, Heinkel, Focke-Wulf and the DFS itself before the plans were handed to Siebel for construction.

propelled by two liquid-feed rockets. The semi-monocoque wing has an area of 20m² and has a span of 9m and has a large sweepback (45°). The spindle-shaped fuselage is of semi-monocoque construction with a maximum diameter of 1.62m. In the nose of it is the pilot's cabin, then comes the pressure cabin for instruments of measuring. In the central part lay the fuel tanks and farther aft the driving gears with the two thrust-jets at the tail.

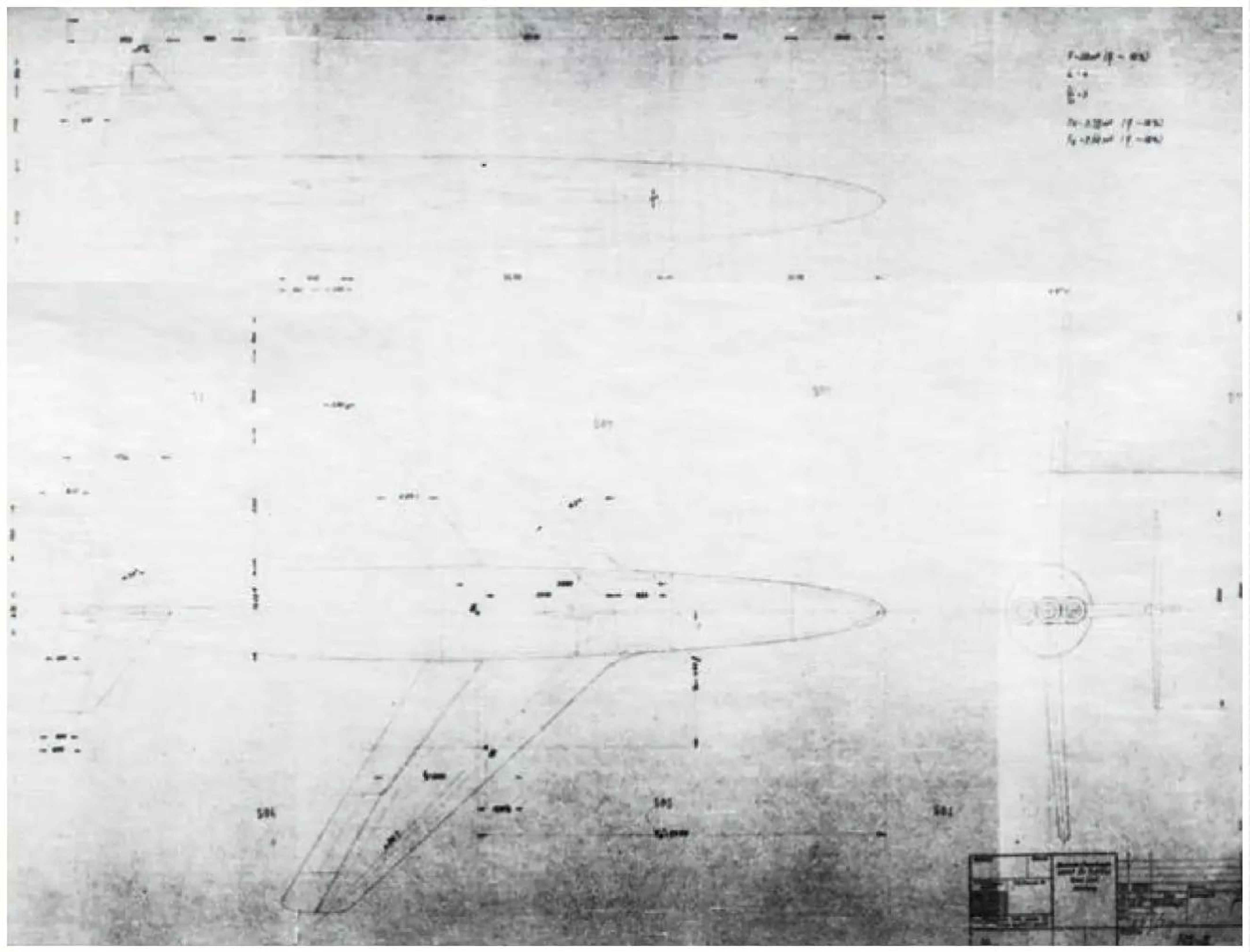
"Also at the tail are fastened the tailplanes, which have likewise large sweepbacks. In the central part of the fuselage is furthermore built in a retractable skid for landing gear. All control surfaces are divided in two parts, the outer part of each has no aerodynamic balance (no nose part before the hinge) and a great proportion of the airfoil depth, so that in the supersonic range it shall remain efficient (by protruding from the Mach angle).

"To avoid a too sensitive control the control systems direct therefore alternatively one part or both parts of the control surfaces. The bottom of the pressure cabin upon which the pilot lies can be ejected and in an arbitrary altitude it will be automatically jettisoned. The whole nose with the pilot's cabin can be blown from the fuselage by means of explosive bolts with which it is fastened. A directional parachute will then slow the descent of the cabin.

"The pressure in the cabin will be regulated with an overpressure valve corresponding to an altitude of 8km. A supply of compressed air is stored on board and the pilot gets oxygen for breathing. In every individual control system is built in a meter to register the forces. The wing is fastened on the fuselage by means of measuring columns so that all forces and moments of the wing in and about the three axes can be measured."

In summing up, Walter wrote: "Since the design of the research airplane 8-346 is very far in progress and the materials and the rocket motor (from the tailless fighter 8-163) are at disposal and since at this time the men of the engineering staff are still accessible (before they are scattered) the building of this plane would be possible in a reasonably short time."

The Americans left Halle on July 1, 1945, having apparently made only cursory efforts to gather documents on the 346 – although anecdotally it has been stated that they did persuade some former Siebel employees to join them in the American zone. Thereafter the Siebel factory was



DFS drawing of the HS-8 dated August 6, 1944. Three rocket motors were projected for this early version of what would become the DFS 346. New evidence suggests that the HS-8 was based on an original Arado design submitted for consideration on July 18, 1944.

immediately occupied by Soviet forces, who gathered together all remaining documents on the 346, along with some 500 men who had worked on the project, and transported them back to Russia. Work on the 8-346 then continued as a Soviet project. ■

For more, see:
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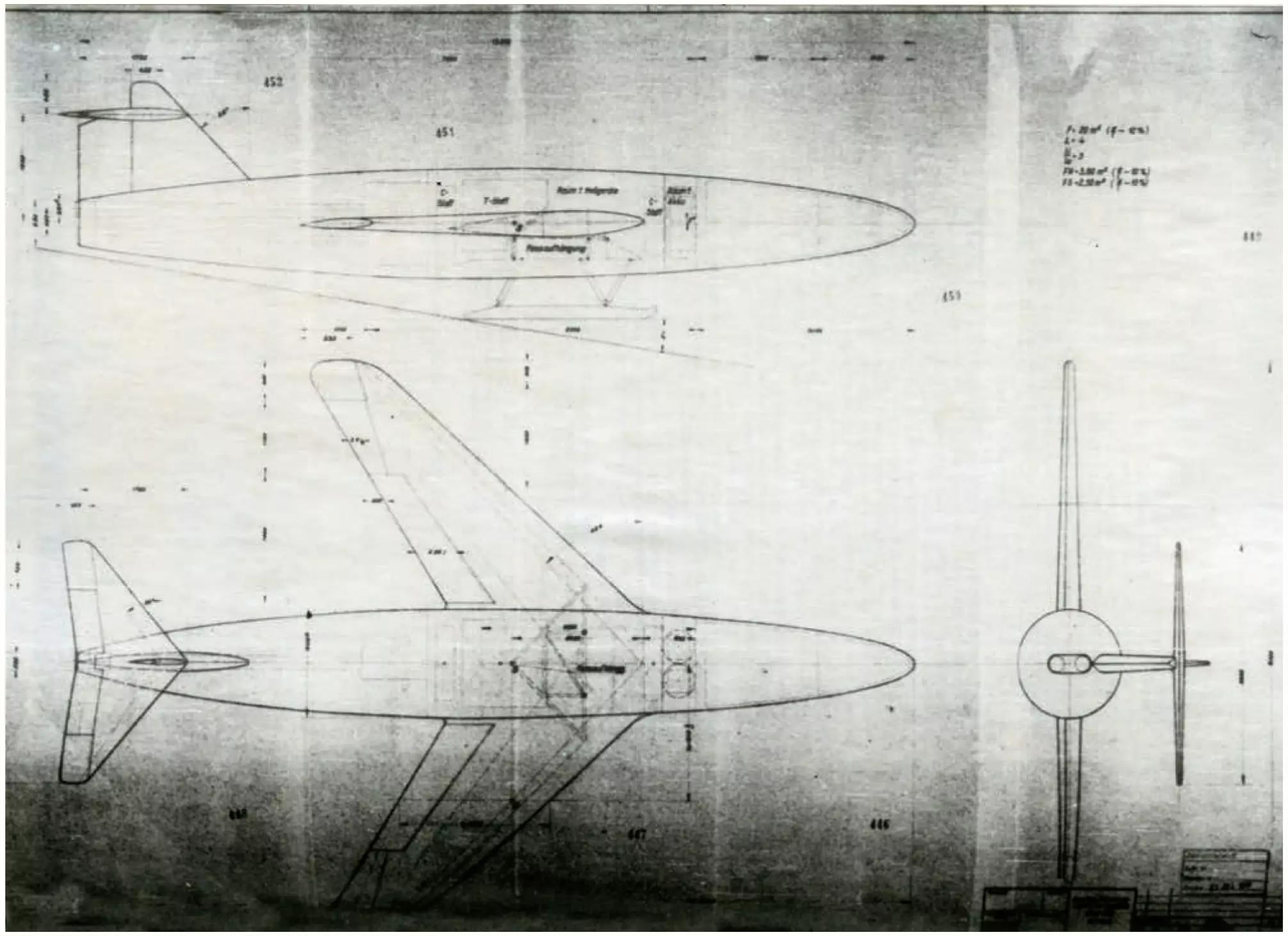

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Drawing of what is termed the "DFS 346 (HS-8) Versuchsflugzeug für Höchstgeschwindigkeiten" from a report dated October 10, 1944. This is relatively close to the design handed to Siebel the following month.

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